GP2000
Portable Radios

Service Manual

6804112J41-O

June, 2001

Computer Software Copyrights

The Motorola products described in this manual may include copyrighted Motorola computer programs stored in semiconductor memories or other media. Laws in the United States and other countries preserve for Motorola certain exclusive rights for copyrighted computer programs, including the exclusive right to copy or reproduce in any form, the copyrighted computer program. Accordingly, any copyrighted Motorola computer programs contained in the Motorola products described in this manual may not be copied or reproduced in any manner without the express written permission of Motorola. Furthermore, the purchase of Motorola products shall not be deemed to grant, either directly or by implication, estoppel or otherwise, any license under the copyrights, patents or patent applications of Motorola, except for the normal non-exclusive royalty-free license to use that arises by operation of law in the sale of a product.

SAFETY INFORMATION

SAFETY AND GENERAL INFORMATION

IMPORTANT INFORMATION ON SAFE AND EFFICIENT OPERATION.

READ THIS INFORMATION BEFORE USING YOUR RADIO.

The information provided in this document supersedes the general safety information contained in user guides published prior to October 2000. For information regarding radio use in a hazardous atmosphere please refer to the Factory Mutual (FM) Approval Manual Supplement or Instruction Card, which is included with radio models that offer this capability.

RADIO FREQUENCY (RF) OPERATIONAL CHARACTERISTICS

To transmit (talk) you must push the Push-To-Talk button; to receive (listen) you must release the Push-To-Talk button. When the radio is transmitting, it generates radio frequency (RF) energy; when it is receiving, or when it is off, it does not generate RF energy.

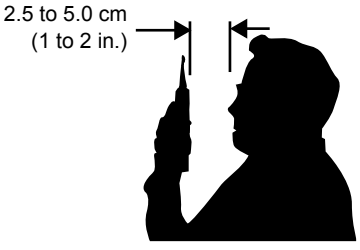
RADIO OPERATION AND EME EXPOSURE

Your Motorola radio is designed to comply with the following national and international standards and guidelines regarding exposure of human beings to radio frequency electromagnetic energy (EME):

- United States Federal Communications Commission, Code of Federal Regulations; 47 CFR part 2 sub-part J
- American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronic Engineers (IEEE) C95.1-1999 Edition
- National Council on Radiation Protection and Measurements (NCRP) of the United States, Report 86, 1986
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6. Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz, 1999
- Australian Communications Authority Radiocommunications (Electromagnetic Radiation - Human Exposure) Standard 1999 (applicable to wireless phones only)

To assure optimal radio performance and make sure human exposure to radio frequency electromagnetic energy is within the guidelines set forth in the above standards, always adhere to the following procedures:

Two-way Radio Operation



When using your radio, hold the radio in a vertical position with the microphone one to two inches (2.5 to 5 centimeters) away from the lips.

Body-worn Operation

To maintain compliance with FCC RF exposure guidelines, if you wear a radio on your body when transmitting, always place the radio in a Motorola approved clip, holder, holster, case, or body harness for this product. Use of non-Motorola-approved accessories may exceed FCC RF exposure guidelines. If you do not use a Motorola approved body-worn accessory and are not using the radio in the intended use positions along side of the head in the phone mode or in front of the face in the two-way radio mode, then ensure the antenna and radio is kept the following minimum distances from the body when transmitting:

- Phone or Two-way radio mode: one inch (2.5 centimeters)
- Data operation using any data feature with or without an accessory cable: one inch (2.5 centimeters)

Antenna Care

Use only the supplied or an approved replacement antenna.
Unauthorized antennas, modifications, or attachments could damage the radio and may violate FCC regulations.

DO NOT hold the antenna when the radio is “IN USE”. Holding the antenna affects call quality and may cause the radio to operate at a higher power level than needed.

Approved Accessories

For a list of approved Motorola accessories look in the appendix or accessory section of your radio’s User Guide.

ELECTROMAGNETIC INTERFERENCE/COMPATIBILITY

NOTE Nearly every electronic device is susceptible to electromagnetic interference (EMI) if inadequately shielded, designed, or otherwise configured for electromagnetic compatibility.

Facilities

To avoid electromagnetic interference and/or compatibility conflicts, turn off your radio in any facility where posted notices instruct you to do so. Hospitals or health care facilities may be using equipment that is sensitive to external RF energy.

Aircraft

When instructed to do so, turn off your radio when on board an aircraft. Any use of a radio must be in accordance with applicable regulations per airline crew instructions.

Medical Devices

- Pacemakers

  The Health Industry Manufacturers Association recommends that a minimum separation of 6 inches (15 centimeters) be maintained between a handheld wireless radio and a pacemaker. These recommendations are consistent with those of the U.S. Food and Drug Administration.

  Persons with pacemakers should:

  - ALWAYS keep the radio more than six inches (15 centimeters) from their pacemaker when the radio is turned ON.
  - not carry the radio in the breast pocket.
  - use the ear opposite the pacemaker to minimize the potential for interference.
  - turn the radio OFF immediately if you have any reason to suspect that interference is taking place.

- Hearing Aids

  Some digital wireless radios may interfere with some hearing aids. In the event of such interference, you may want to consult your hearing aid manufacturer to discuss alternatives.

- Other Medical Devices

  If you use any other personal medical device, consult the manufacturer of your device to determine if it is adequately shielded from RF energy. Your physician may be able to assist you in obtaining this information.

SAFETY AND GENERAL

Use While Driving

Check the laws and regulations on the use of radios in the area where you drive. Always obey them.

When using your radio while driving, please:

- Give full attention to driving and to the road.
- Use hands-free operation, if available.
- Pull off the road and park before making or answering a call if driving conditions so require.

OPERATIONAL WARNINGS

For Vehicles With An Air Bag

WARNING

Do not place a portable radio in the area over an air bag or in the air bag deployment area. Air bags inflate with great force. If a portable radio is placed in the air bag deployment area and the air bag inflates, the radio may be propelled with great force and cause serious injury to occupants of the vehicle.

Potentially Explosive Atmospheres

Turn off your radio prior to entering any area with a potentially explosive atmosphere, unless it is a radio type especially qualified for use in such areas as “Intrinsically Safe” (for example, Factory Mutual, CSA, UL, or CENELEC). Do not remove, install, or charge batteries in such areas. Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or even death.

NOTE The areas with potentially explosive atmospheres referred to above include fueling areas such as below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles, such as grain, dust or metal powders, and any other area where you would normally be advised to turn off your vehicle engine. Areas with potentially explosive atmospheres are often but not always posted.

Blasting Caps And Areas

To avoid possible interference with blasting operations, turn off your radio when you are near electrical blasting caps, in a blasting area, or in areas posted: “Turn off two-way radio.” Obey all signs and instructions.

OPERATIONAL CAUTIONS

Antennas

Caution

Do not use any portable radio that has a damaged antenna. If a damaged antenna comes into contact with your skin, a minor burn can result.

Batteries

All batteries can cause property damage and/or bodily injury such as burns if a conductive material such as jewelry, keys, or beaded chains touch exposed terminals. The conductive material may complete an electrical circuit (short circuit) and become quite hot. Exercise care in handling any charged battery, particularly when placing it inside a pocket, purse, or other container with metal objects.

Table of Contents

Section 1 INTRODUCTION

1.0 Scope of Manual 1-1
2.0 Warranty and Service Support 1-1
2.1 Warranty Period and Return Instructions 1-1
2.2 After Warranty Period 1-1
2.3 Piece Parts 1-2
2.4 Technical Support 1-2
3.0 Radio Model Information 1-3

Section 2 MAINTENANCE

1.0 Introduction 2-1
2.0 Preventive Maintenance 2-1
2.1 Inspection 2-1
2.2 Cleaning Procedures 2-1
3.0 Safe Handling of CMOS and LDMOS Devices 2-2
4.0 Repair Procedures and Techniques — General 2-3
5.0 Disassembling and Reassembling the Radio — General 2-4
6.0 Radio Disassembly — Detailed 2-5
6.1 Front Cover from Chassis Disassembly 2-5
6.2 Control Board Disassembly 2-7
6.3 RF Board Disassembly 2-7
7.0 Radio Reassembly — Detailed 2-8
7.1 RF Board Reassembly 2-8
7.2 Control Board Reassembly 2-8
7.3 Chassis and Front Cover Reassembly 2-8
8.0 Mechanical View and Parts List 2-11
8.1 Exploded View and Parts List 2-11
9.0 Service Aids 2-14
10.0 Test Equipment 2-15
11.0 Programming Cable (DSK001C706) 2-16
12.0 IF Test Box (DSK001C702) 2-17

Section 3 RADIO TUNING

1.0 Introduction 3-1
2.0 Radio Tuning Setup 3-2

Section 4 RADIO PROGRAMMING

1.0 Introduction 4-1
2.0 CPS Programming Setup 4-1
3.0 Programming Your Radio 4-2
3.1 Overview of the Programming Process 4-2

3.2 Cloning Radio Parameters to User Radios 4-2
3.3 Parameters which are cloned 4-2
3.4 Parameters which are not cloned 4-2
3.5 To Clone a Radio 4-2
3.6 Error Conditions 4-3
3.7 Dealer and User Configurations 4-3
4.0 Programming Mode 4-4
4.1 Introduction 4-4
4.2 Entering Programming Mode 4-4
4.3 Exiting Programming Mode 4-4
4.4 Accessing Programming Mode Parameters 4-4
4.5 Editing RW (Radio Wide) Parameters 4-5
4.6 Editing Channel Parameters 4-11
4.7 Editing VFO Parameters 4-14
4.8 PL Frequencies and Codes 4-18
4.9 DPL Codes 4-19
4.10 Examples 4-20
4.11 Factory Reset 4-22

Section 5 Error Code Displays

1.0 Error Codes 5-1

Section 6 ACCESSORIES

1.0 Antennas 6-1
2.0 Carrying Accessories 6-1
3.0 Carry Cases 6-1
4.0 Chargers 6-2
5.0 Batteries 6-2
6.0 Audio Accessories 6-2
7.0 Manuals 6-2
8.0 Service Kits 6-3

Section 7 VHF Band Information (136-174 Mhz)

1.0 Model Chart 7-1
2.0 Specifications 7-3
3.0 Theory of Operation 7-4
3.1 General Information 7-4
3.2 Power Distribution 7-4
3.3 Power up Sequence 7-4
3.4 CPU / Control Section 7-5
3.5 VCO / Synthesizer Section 7-5
3.6 Transmitter Section 7-6
3.7 Receiver Section 7-7
3.8 Battery Section 7-8

4.0 Block Diagrams 7-9
4.1 Complete 7-9
4.2 Controller 7-10
4.3 VCO 7-10
4.4 Transmitter 7-11
4.5 Receiver 7-11
5.0 Circuit Board/Schematic Diagrams and Parts List 7-13
Controller Board 7-13
VHF 136-174 MHz Main Board Top Side 7-14
VHF 136-174 MHz Main Board Bottom Side 7-15
Complete Controller Board Schematic Diagram 7-16
VHF 136-174 MHz RF Board Schematic Diagram 7-17
VHF 136-174 MHz Radio Parts List (Controller Board) 7-18
6.0 Troubleshooting charts 7-27
Troubleshooting Flow Chart for Receiver 7-27
Troubleshooting Flow Chart for Transmitter 7-28
Troubleshooting Flow Chart for Synthesizer 7-29
Troubleshooting Flow Chart for Microcontroller 7-30
Troubleshooting Flow Chart for VCO 7-31

Glossary of Terms G-1

Section 1

INTRODUCTION

1.0 Scope of Manual

This manual is intended for use by service technicians familiar with similar types of equipment. It contains service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date may be incorporated by a complete Manual revision or alternatively as additions.

NOTE Before operating or testing these units, please read the Safety Information Section in the front of this manual.

2.0 Warranty and Service Support

Motorola offers long term support for its products. This support includes full exchange and/or repair of the product during the warranty period, and service/ repair or spare parts support out of warranty. Any "return for exchange" or "return for repair" by an authorised Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorised Motorola Dealer.

2.1 Warranty Period and Return Instructions

The terms and conditions of warranty are defined fully in the Motorola Dealer or Distributor or Reseller contract. These conditions may change from time to time and the following notes are for guidance purposes only.

In instances where the product is covered under a "return for replacement" or "return for repair" warranty, a check of the product should be performed prior to shipping the unit back to Motorola. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

Prior to shipping any radio back to the appropriate Motorola warranty depot, please contact Customer Resources (Please see page 2 and page 3 in this Chapter). All returns must be accompanied by a Warranty Claim Form, available from your Customer Services representative. Products should be shipped back in the original packaging, or correctly packaged to ensure no damage occurs in transit.

2.2 After Warranty Period

After the Warranty period, Motorola continues to support its products in two ways.

1. Motorola's Accessories and Aftermarket Division (AAD) offers a repair service to both end users and dealers at competitive prices.
2. AAD supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair.

2.3 Piece Parts

Some replacement parts, spare parts, and/or product information can be ordered directly. If a complete Motorola part number is assigned to the part, it is available from Motorola's Accessories and Aftermarket Division (AAD). If no part number is assigned, the part is not normally available from Motorola. If the part number is appended with an asterisk, the part is serviceable by Motorola Depot only. If a parts list is not included, this generally means that no user-serviceable parts are available for that kit or assembly.

All orders for parts/information should include the complete Motorola identification number. All part orders should be directed to your local AAD office. Please refer to your latest price pages.

2.4 Technical Support

Technical support is available to assist the dealer/distributor in resolving any malfunction which may be encountered. Initial contact should be by telephone wherever possible. When contacting Motorola Technical Support, be prepared to provide the product model number and the unit's serial number.

Toll-Free

Location	Number
Australia	1800-774457
China	800-810-0976
Hong Kong SAR	25904800
Indonesia	0800-1-686868
Korea	080-300-7400
Malaysia	1800-801687
New Zealand	0800-442109
Philippines	1800-16510271
Singapore	1800-4855333
Taiwan	0080-651661
Thailand (outside Bangkok)	088-225412

Non-Toll-Free

Location	Number
India	80-6658922
Thailand (Bangkok area)	2548388
All Other Countries	IDD Code+(65)-4855333

3.0 Radio Model Information

The model number and serial number are located on a label attached to the back of your radio. You can determine the RF output power, frequency band, protocols, and physical packages. The example below shows one portable radio model number and its specific characteristics.

Table 1-1 Radio Model Number (Example: AZH49KBH6AA9)

	Type of Unit	Model Series	Freq. Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level
AZ	H	49	K (136-174 MHz)	B 1W	F Limited Keypad with Display	4 12.5K	AA Conventional	6 GP2100
			N (216-257 MHz)	C 4W	H Full Keypad with Display	6 20/25K		9 GP2000
			Q (403-440 MHz)	D 5W		8 12.5/25K		
			R (435-480 MHz)					

H = Portable

AZ = Asia Regional Prefix

This page is intentionally left blank.

Section 2

MAINTENANCE

1.0 Introduction

This chapter provides details about the following:

- Preventive Maintenance
- Safe Handling of CMOS and LDMOS Devices
- General Repair Procedures and Techniques
- Disassembling and Reassembling the Radio

2.0 Preventive Maintenance

The radios do not require a scheduled preventive maintenance program; however, periodic visual inspection and cleaning is recommended.

2.1 Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. It is not recommended to inspect the interior electronic circuitry.

2.2 Cleaning Procedures

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the radio. External surfaces include the front cover, housing assembly and battery case. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime.

NOTE Internal surfaces should be cleaned only when the radio is disassembled for service or repair.

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (70% by volume).

CAUTION: The effects of certain chemicals and their vapors can have harmful results on certain plastics. Avoid using aerosol sprays, tuner cleaners, and other chemicals.

Cleaning External Plastic Surfaces

Apply the 0.5% detergent-water solution sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. Use a soft, absorbent, lintless cloth or tissue to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

Cleaning Internal Circuit Boards and Components

Isopropyl alcohol (70%) may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio. Make sure that controls or tunable components are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since this could cause the liquid to collect in unwanted places. After completing of the cleaning process, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover.

NOTE Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

3.0 Safe Handling of CMOS and LDMOS Devices

Complementary metal-oxide semiconductor (CMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS circuits and are especially important in low humidity conditions. DO NOT attempt to disassemble the radio without first referring to the following CAUTION statement.

CAUTION: This radio contains static-sensitive devices. Do not open the radio unless you are properly grounded. Take the following precautions when working on this unit:

- Store and transport all CMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS devices into conventional plastic “snow” trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench to protect the CMOS device. We recommend using the Motorola Static Protection Assembly (part number 0180386A82), which includes a wrist strap, two ground cords, a table mat, and a floor mat.
- Wear a conductive wrist strap in series with a 100k resistor to ground. (Replacement wrist straps that connect to the bench top covering are Motorola part number RSX-4015.)
- Do not wear nylon clothing while handling CMOS devices.
- Do not insert or remove CMOS devices with power applied. Check all power supplies used for testing CMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- If at all possible, handle CMOS devices by the package and not by the leads. Prior to touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

4.0 Repair Procedures and Techniques — General

Parts Replacement and Substitution

When damaged parts are replaced, identical parts should be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola part number and order the part from the nearest Motorola Communications parts center listed in the Piece Parts section of this manual.

Rigid Circuit Boards

This family of radios uses bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The printed-through holes may interconnect multiple layers of the printed circuit. Therefore, exercise care to avoid pulling the plated circuit out of the hole.

When soldering near the 20-pin and 40-pin connectors:

- Avoid accidentally getting solder in the connector.
- Be careful not to form solder bridges between the connector pins.
- Examine your work closely for shorts due to solder bridges.

Flexible Circuits

The flexible circuits are made from a different material than the rigid boards, and require different soldering techniques. Excessive prolonged heat on a flexible circuit can damage the material. Therefore, avoid excessive heat and excessive bending.

For parts replacement, use the ST-1087 Temperature-Controlled Solder Station with a 600-700 degree F tip, and use small diameter solder such as ST-633. The smaller size solder will melt faster and require less heat to be applied to the circuit.

To replace a component on a flexible circuit:

1. Grasp with seizers (hemostats) the edge of the flexible circuit near the part to be removed.
2. Pull gently.
3. Apply the tip of the soldering iron to the component connections while pulling with the seizers.

NOTE Do not attempt to puddle-out components. Prolonged application of heat may damage the flexible circuit.

Chip Components

Use either the RLN-4062 Hot-Air Repair Station or the Motorola 0180381B45 Repair Station for chip component replacement. When using the 0180381B45 Repair Station, select the TJ-65 mini-thermojet hand piece. On either unit, adjust the temperature control to 700 degrees F. (370 degrees C), and adjust the airflow to a minimum setting. Airflow can vary due to component density.

- To remove a chip component, select a hot-air hand piece and position the nozzle of the hand piece approximately 1/8” above the component to be removed. Begin applying the hot air. Once the solder reflows, remove the component using a pair of tweezers. Using solder wick and a soldering iron or a power desoldering station, remove the excess solder from the pads.

- To replace a chip component using a soldering iron, select the appropriate micro-tipped soldering iron and apply fresh solder to one of the solder pads. Using a pair of tweezers, position the new chip component in place while heating the fresh solder. Once solder wicks onto the new component, remove the heat from the solder. Heat the remaining pad with the soldering iron and apply solder until it wicks to the component. If necessary, touch up the first side. All solder joints should be smooth and shiny.
- To replace a chip component using hot air, select the hot-air hand piece and reflow the solder on the solder pads to smooth it. Apply a drop of solder paste flux to each pad. using a pair of tweezers, position the new component in place. Position the hot-air hand piece approximately 1/8” above the component and begin applying heat. Once the solder wicks to the component, remove the heat and inspect the repair. All joints should be smooth and shiny.

Shields

Removing and replacing shields will be done with the R-1070 station with the temperature control set to approximately 415°F (215°C); 445°F (230°C) max.

- To remove the shield, place the circuit board in the R-1070’s holder. Select the proper heat focus head and attach it to the heater chimney. Add solder paste flux around the base of the shield. Position the shield under the heat-focus head. Lower the vacuum tip and attach it to the shield by turning on the vacuum pump. Lower the focus head until it is approximately 1/8” (0.3cm) above the shield. Turn on the heater and wait until the shield lifts off the circuit board. Once the shield is off, turn off the heat, grab the part with a pair of tweezers, and turn off the vacuum pump. Remove the circuit board from the R-1070’s circuit board holder.
- To replace the shield, add solder to the shield if necessary, using a micro-tipped soldering iron. Next, rub the soldering iron tip along the edge of the shield to smooth out any excess solder. Use solder wick and a soldering iron to remove excess solder from the solder pads on the circuit board. Place the circuit board back in the R1070’s circuit board holder. Place the shield on the circuit board using a pair of tweezers. Position the heat-focus head over the shield and lower it to approximately 1/8” above the shield. Turn on the heater and wait for the solder to reflow.
  Once complete, turn off the heat, raise the heat-focus head and wait approximately one minute for the part to cool. Remove the circuit board and inspect the repair. No cleaning should be necessary.

5.0 Disassembling and Reassembling the Radio — General

Since these radios may be disassembled and reassembled with the use of only four (board to casting) screws, it is important to pay particular attention to the snaps and tabs, and how parts align with each other.

The following tools are required for disassembling the radio:

- Phillips screwdriver
- 4mm socket wrench

If a unit requires more complete testing or service than is customarily performed at the basic level, send this unit to a Motorola Authorized Service Center.

6.0 Radio Disassembly — Detailed

6.1 Front Cover from Chassis Disassembly

1. Turn off the radio.
2. Remove the battery:
   a. Slide the battery clasp away from the radio (see “Figure 2-1”).

Figure 2-1

   b. Slide battery down and away from radio.
3. Remove the antenna.
4. Pull the On/Off Volume knob off of its shaft.
5. Remove the two screws at the back of the rear chassis (see “Figure 2-2”).

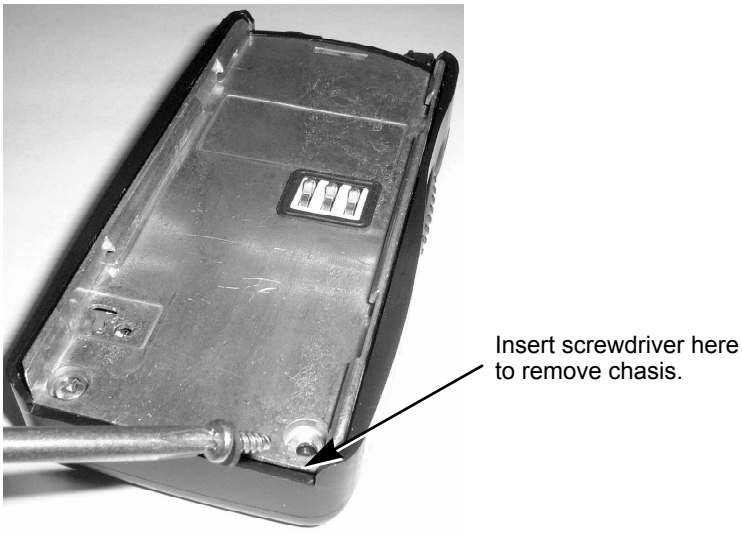


Figure 2-2

6. Insert a small flat-head screw driver at the bottom of the radio, between the chassis and housing (location marked in "Figure 2.2"), and lift the chassis gently. Be careful not to damage

the housing or the O-ring underneath.

7. Lift rear chassis away from the front cover (see “Figure 2-3”). Be careful not to damage the speaker wire underneath.

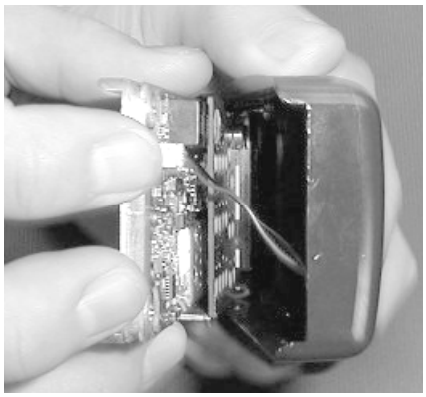


Figure 2-3

8. Slide the rear chassis downwards, and away from the front cover.
9. Remove the speaker connector, which connects between RF Board and the internal speaker on front cover (see “Figure 2-4”).

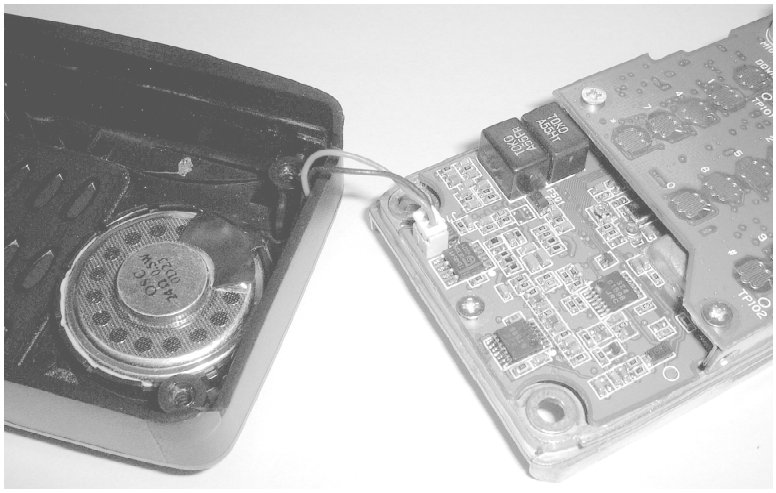


Figure 2-4

6.2 Control Board Disassembly

1. Remove the screws which hold the control board to the RF board.
2. Remove the control board (the control board is connected to the RF board through a board-to-board connector -- see “Figure 2-5”).

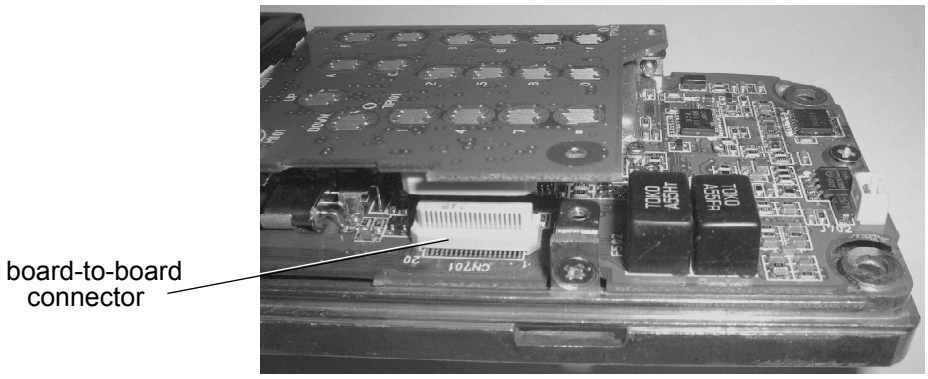


Figure 2-5

6.3 RF Board Disassembly

1. Remove the screws and the stud which hold the RF board to the rear diecast with the Phillips head screw driver and socket wrench respectively.
2. Gently remove the RF board from rear diecast. The completely disassembly radio is shown in “Figure 2-6”.

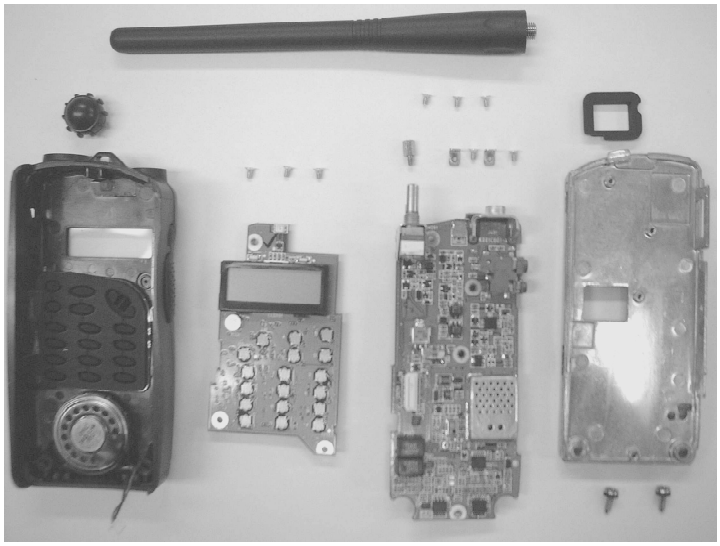


Figure 2-6 Completely Disassembled Radio

7.0 Radio Reassembly — Detailed

7.1 RF Board Reassembly

1. Place the RF board on the rear diecast.
2. Tighten the screws and the stud.

7.2 Control Board Reassembly

1. Place the control board on the RF board.
2. Connect the control board to the RF board by pressing it firmly downwards at the board-to-board connector (see “Figure 2-7”).

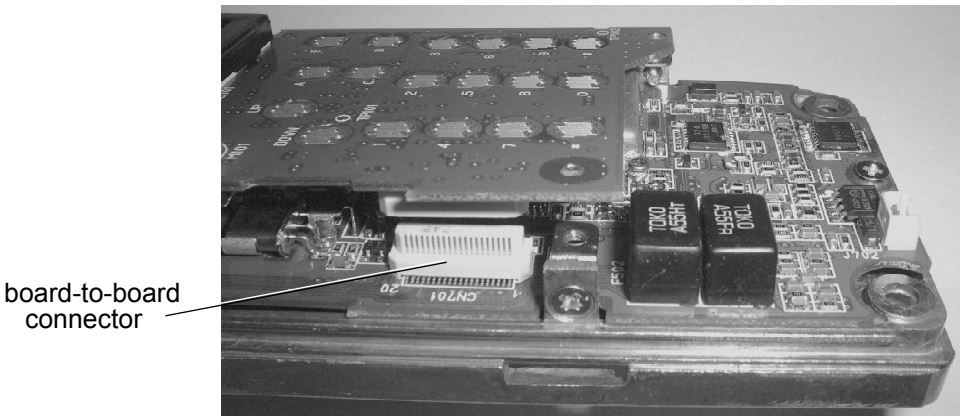


Figure 2-7

3. Tighten the screws using screwdriver to hold the control board in place.

7.3 Chassis and Front Cover Reassembly

1. Connect the RF board to the internal speaker on front cover with the speaker connector (see “Figure 2-8”).

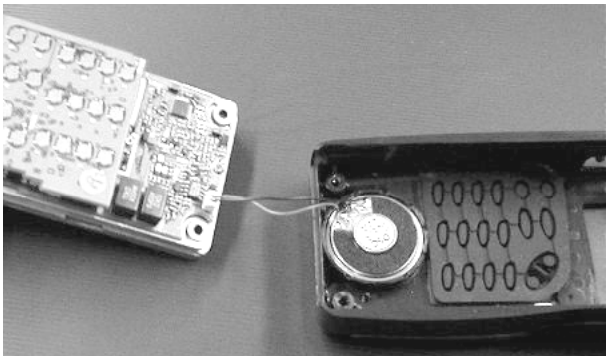


Figure 2-8

2. Place the front cover over the tabs on the rear diecast.
3. Insert the On/Off Volume shaft into the front cover opening.

4. Lower the front cover until the bottom edges snap firmly into place on the rear diecast (see “Figure 2-9”)

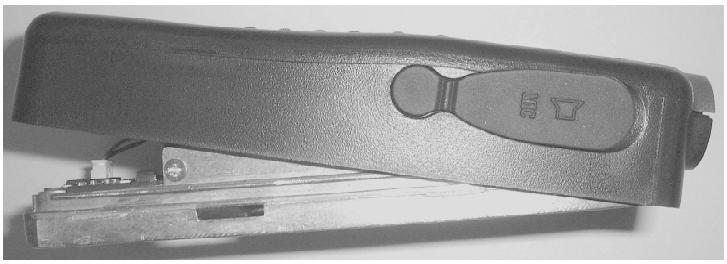


Figure 2-9

5. Tighten the two (2) screws at the bottom of rear diecast using a screwdriver (see “Figure 2-10”).

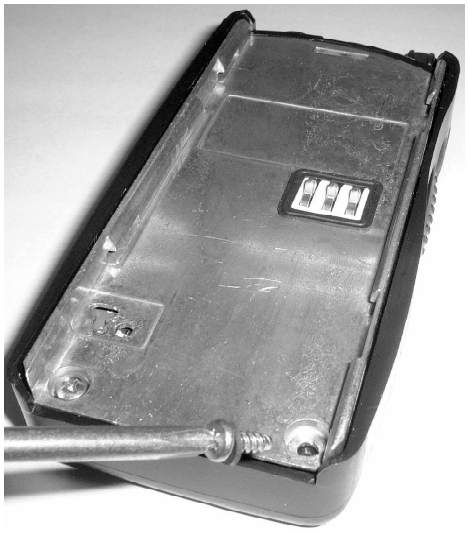


Figure 2-10

6. Attach the battery.

7. Attach the On/Off Volume Knob, and Antenna.

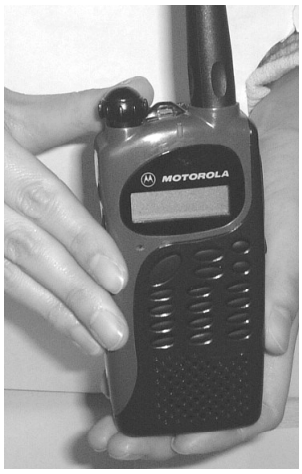


Figure 2-11 Completely Reassembled radio.

8.0 Mechanical View and Parts List

8.1 Exploded View and Parts List

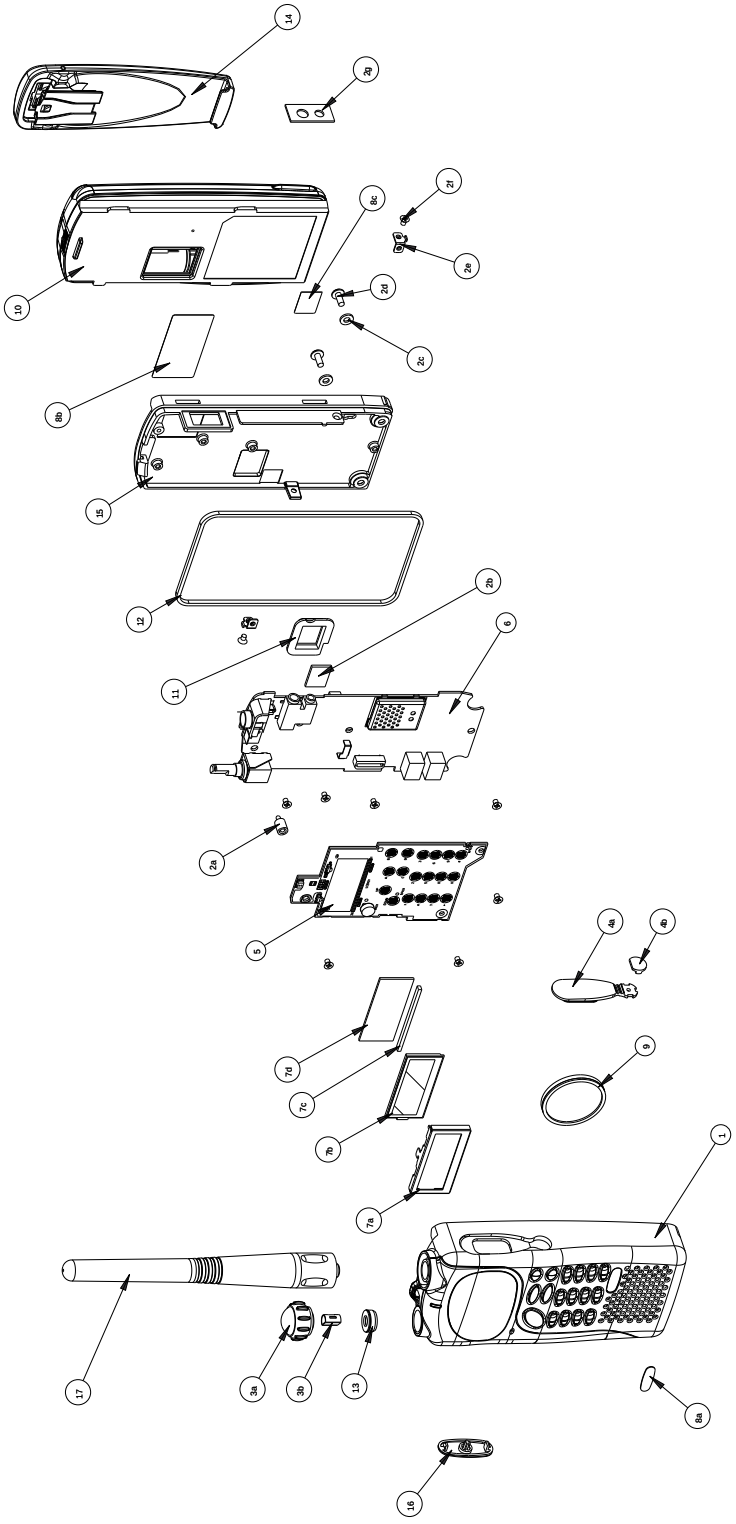


Figure 2-12 Alpha Series Radio Exploded View

Item	Part Number	Description
1	DS1M001110	Front Cover Kit
2	DS1M001120	Chassis Hardware Kit
2a		*Rod (M2)*
2b		*Heatsink Tape*
2c		*Gasket (Screw M2.6)*
2d		*Screw M2.6*
2e		*PCB Bracket*
2f		*Screw M2 Cfims*
2g		*External Tape*
3	DS1M001130	Knob Assembly
3a		*Knob*
3b		*Spring (D4.75)*
4	DS1M001140	External Cover Kit
4a		*External Cover*
4b		*External Cover Cap*
5	DS1M001150	Controller Board Assembly
6	DS1M001160	RF Board Assembly
7	DS1M001170	LCD Kit
7a		*LCD Bracket*
7b		*LCD*
7c		*Interconnector*
7d		*Reflector*
8	DS1M001180	Label Kit
8a		*Label (Nameplate)*
8b		*Label (Serial)*
8c		*Label (Tuning)*
9	DS1M001190	Speaker Assembly
10	PMNN4046	Battery
11	DSM2192004	Contact Gasket
12	DSM2192005	Main Gasket

Item	Part Number	Description
13	DSM2192006	Volume Gasket
14	HLN9844	Beltclip
15	DSM5190001	Back Housing
16	DSM6189003	PTT Button
17	Frequency dependant. Please see "Antennas" on page 6-1	Antenna

9.0 Service Aids

Table 2-1 lists service aids recommended for working on the Alpha Series Radios. While all of these items are available from Motorola, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 2-1 Service Aids

Motorola Part No.	Description	Application
PMVN4059_	Customer Programming Software - Software on 3.5” floppy diskettes	Program customer option and channel data.
PMVN4061_	Customer Programming Software - Software on CD Rom	Program customer option and channel data.
PMVN4060_	Tuner - Software on 3.5” floppy diskettes	Tune hardware parameters, front end, power, etc.
PMVN4062_	Tuner - Software on CD Rom	Tune hardware parameters, front end, power, etc.
DSK001C706	Programming Cable (2.5mm)	Connects radio and IF Test Box to Computer.
PMKN4003A	Cloning Cable (2.5mm)	To clone programmable information from one radio to another radio.
DSK001C704	Test Cable	Connects radio to IF Test Box.
DSK001C714	Interconnect Service Cable	Connects RF board and CPU board.
DSK001C702	IF Test Box	Enables connection to the audio/accessory jack. Allows switching for radio testing.
DSK001C705	Battery Eliminator	Interconnects radio to power supply (red-and-black power cable included).
HLN8262A	BNC Adaptor	Adapts radio’s antenna port to BNC cabling of test equipment.
ENG/DA51	Ceramic Tuning Tool	To tune the variable resistor (RV601 for audio modulation adjustment and RV602 for sub-audio modulation adjustment).
	4 mm Socket Wrench	Used to remove hexagon stud from the RF board.
	Phillips Head Screwdriver	Used to remove M2 and M2.6 Phillips screws.
TT907A National Service Technical Guide	Repairing Leadless Component Assemblies	How to successfully remove and replace surface mount devices.

10.0 Test Equipment

Table 2-2 lists test equipment required to service the Alpha Series Radios and other two-way radios.

Table 2-2 Recommended Test Equipment

Motorola Part No.	Description	Characteristics	Application
R2000 or R2400	Service Monitor	This monitor will substitute for items with an asterisk *	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1049	Digital Multimeter		Two meters recommended for AC/DC voltage and current measurements
*S1100	Audio Oscillator	67 to 200Hz tones	Used with service monitor for injection of PL tones
*S1053, *SKN6009, *SKN6001	AC Voltmeter, Power Cable for meter, Test leads for meter	1 mV to 300 V, 10 Mega Ohm input impedance	Audio voltage measurements
R1053	Dual-trace Oscilloscope	20 MHz bandwidth, 5 mV/cm - 20 V/cm	Waveform measurements
*S1350, *ST1215 (VHF) *ST1223 (UHF) *T1013	Wattmeter, Plug-in Elements (VHF & UHF), RF Dummy Load	50-Ohm, ±5% accuracy 10 W, max. 0-1000 MHz, 300 W	Transmitter power output measurements
S1339	RF Millivolt Meter	100 μV to 3 VRF, 10 kHz to 1.2 GHz	RF level measurements
*R1013	SINAD Meter		Receiver sensitivity measurements
S1347 or S1348 (prog)	DC Power Supply	0-20 Vdc, 0-5 Amps	Bench supply for 7.5Vdc

11.0 Programming Cable (DSK001C706)

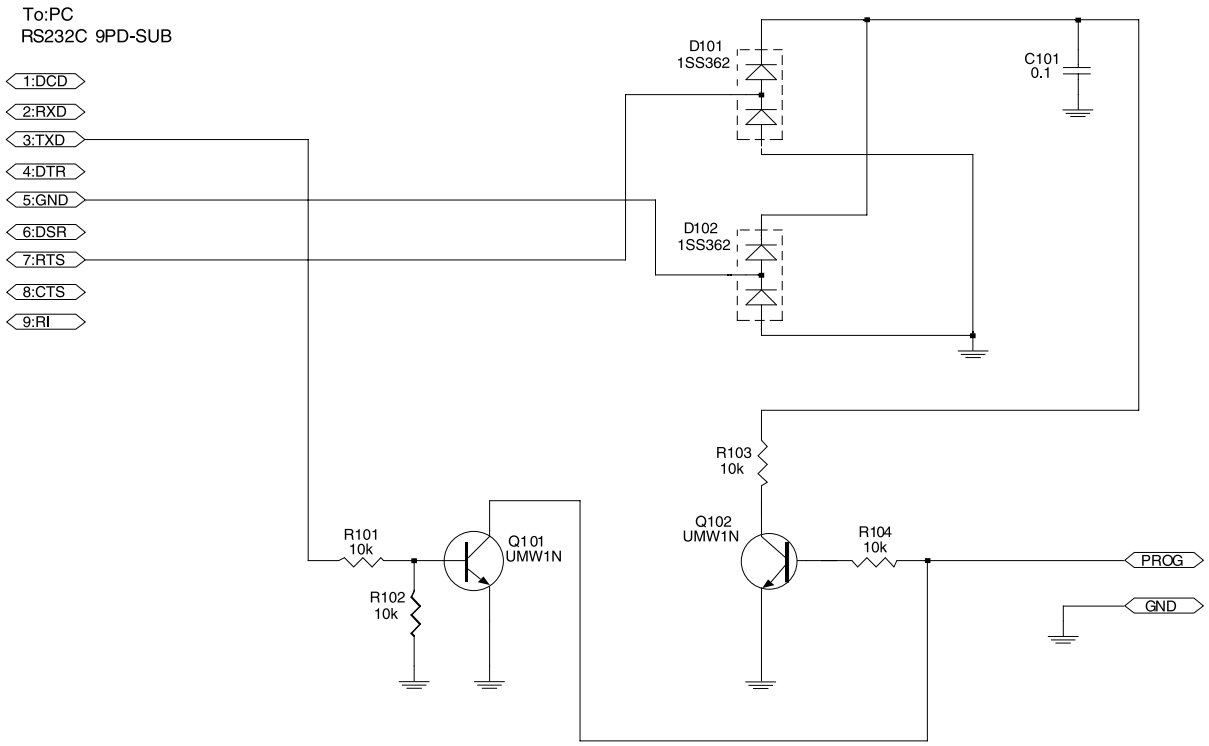


Figure 2-13 Programming Cable Schematic

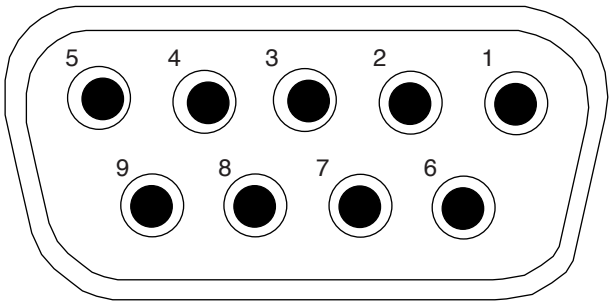


Figure 2-14 Pin Configuration of the Side Connector

12.0 IF Test Box (DSK001C702)

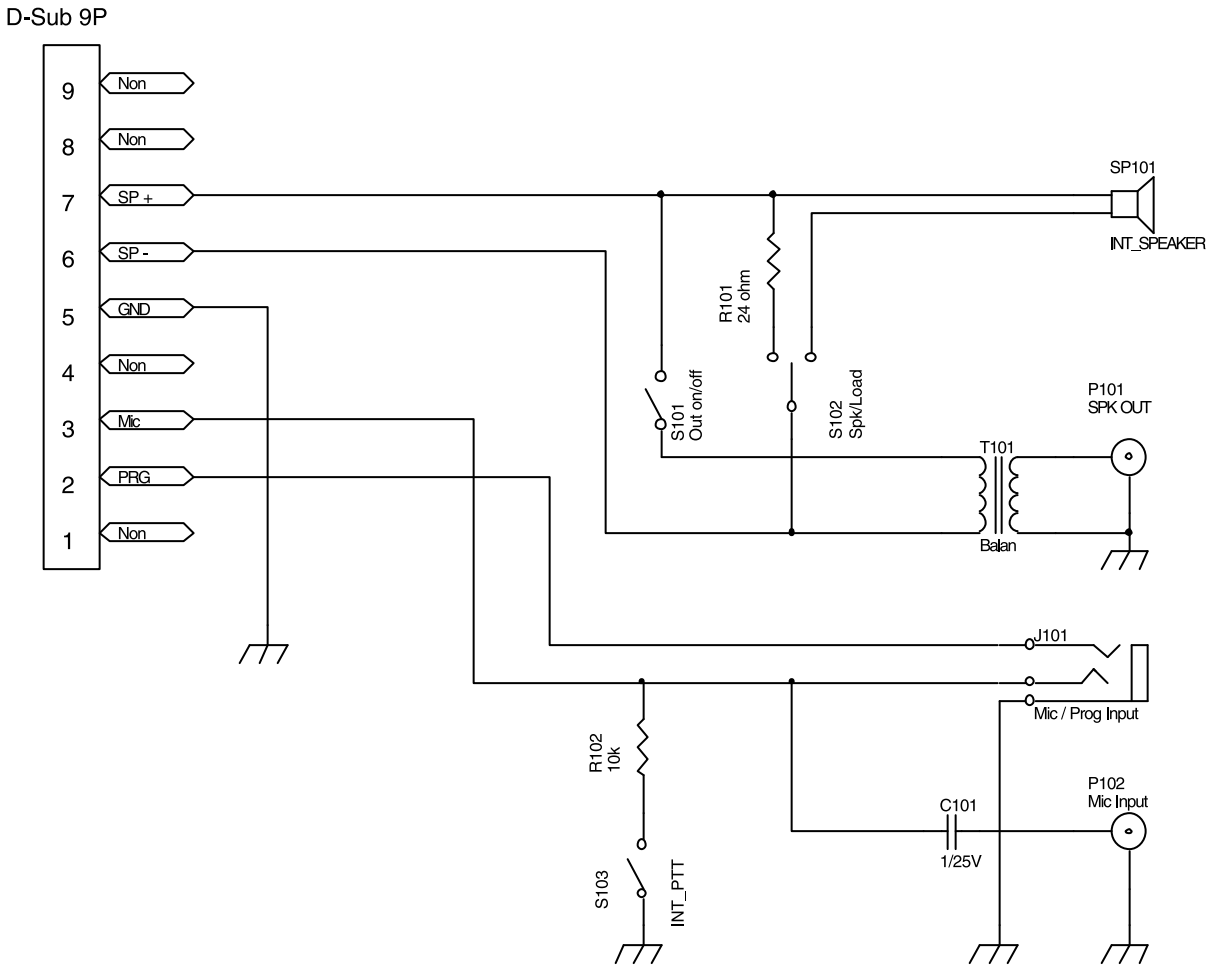


Figure 2-15 IF Test Box Schematic

This page is intentionally left blank.

Section 3

RADIO TUNING

1.0 Introduction

This chapter provides an overview of the software and hardware tuning for Alpha Series Radio.

The Alpha Series Radios Universal Tuner is designed for use in a Windows 95/98/NT environment. This software and the Customer Programming Software (see page 4-1) essentially cover all the functions of the traditional Radio Service Software (RSS) package.

An Installation instruction manual is contained within each kit.

Description	Kit Number
Tuner Installation Kit (Disk)	PMVN4060_
Tuner Installation Kit (CD)	PMVN4062_

2.0 Software Tuning Setup

A Windows 95/98/NT PC (personal computer) and Tuner are required to tune parameters such as power, sensitivity, squelch and RSSI. To perform the tuning procedures, the radio must be connected to the PC and IF Test Set as shown in figure below.

Refer to online help files for the tuning procedures.

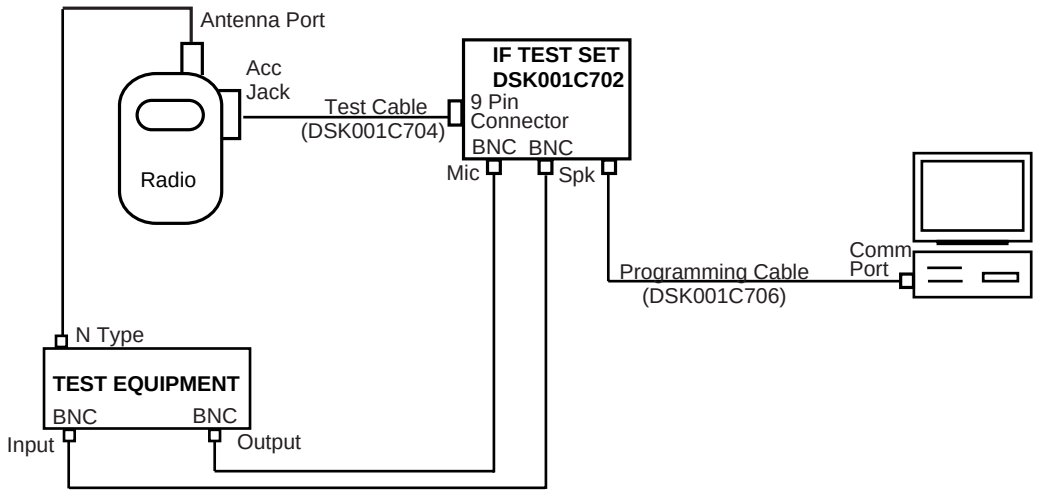


Figure 3-1 Radio Tuning Setup

3.0 Hardware Tuning Setup and Procedure

There is a silver seal on the bottom left of the radio chassis. Remove the seal to expose the two potentiometers for audio and sub-audio (CTCSS) modulation adjustment. RV601, which is slightly higher, is the trimmer potentiometer for audio modulation tuning. The lower trimmer potentiometer (RV602) is meant for sub-audio modulation tuning.

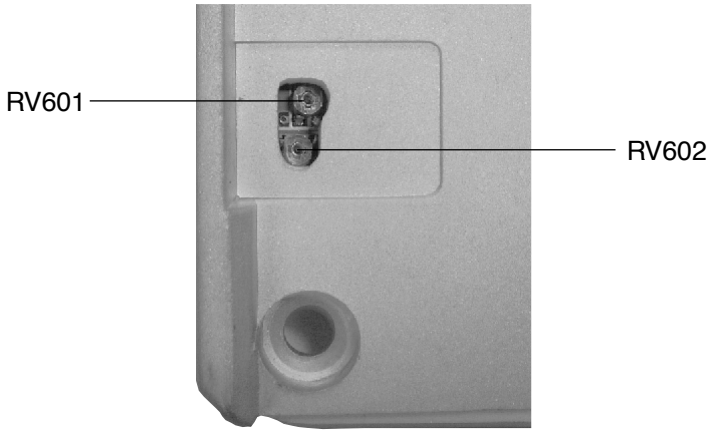


Figure 3-2 Tuning Ports

3.1 Audio Modulation Tuning

1. Set the radio to transmit at 155.025MHz with low power. Set Channel Spacing to "CS-25.0" for 25kHz (see "*Radio Programming*" on page 4-1).
2. On the test equipment, set it to receive at 155.025MHz and with the following configurations :

   Audio bandwidth: 0.25Hz to 15,000Hz.
   De-emphasis: OFF
3. Inject a 60mV 1kHz tone to the radio through the extenal mic connector.
4. Key up the radio.
5. Using the ceramic tuning tool, adjust RV601 to tune the audio modulation deviation to settle between 4.3kHz to 4.5kHz.

3.2 Sub-Audio Modulation Tuning

1. Set the radio to transmit at 155.025MHz with low power and Tx PL frequency of 100.0Hz. Set Channel Spacing to "CS-25.0" for 25kHz (see "*Radio Programming*" on page 4-1).
2. On the test equipment, set it to receive at 155.025MHz and with the following configurations :

   Audio bandwidth: 0.25Hz to 3,000Hz.
   De-emphasis : OFF
3. Do **NOT** inject any tone to the radio.
4. Key up the radio.
5. Using the ceramic tuning tool, adjust RV602 to tune the sub-audio modulation deviation to settle between 0.65kHz to 0.75kHz.

Section 4

RADIO PROGRAMMING

1.0 Introduction

This chapter provides an overview of the Alpha Series Radios Customer Programming Software (CPS), which has been designed for use in a Windows 95/98/NT environment.

An Installation instruction manual is contained within each kit.

Description	Kit Number
Alpha Series Radio CPS Installation Kit (Disk)	PMVN4059_
Alpha Series Radio CPS Installation Kit (CD)	PMVN4061_

2.0 CPS Programming Setup

Refer to online help files for the CPS Programming procedures.

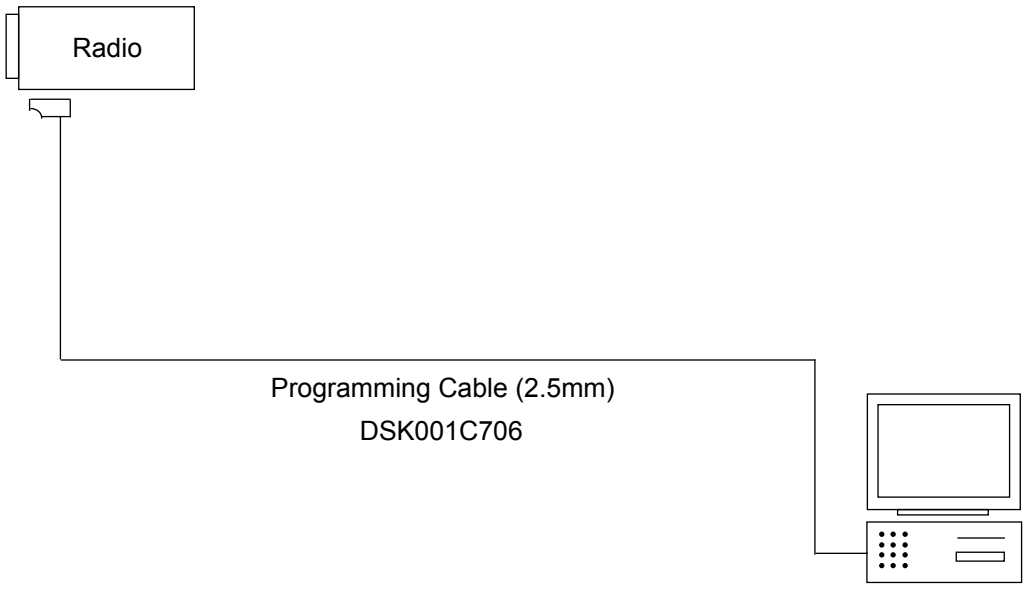


Figure 4-1 CPS Programming Setup

3.0 Programming Your Radio

3.1 Overview of the Programming Process

To prepare properly programmed radios for your customers, you should

1. program your radio with all the necessary parameters, as required by your customers, and then
2. clone these parameters over to all your customer's radios.

3.2 Cloning Radio Parameters to User Radios

Cloning duplicates the contents of Radio 1 (master radio) into Radio 2 (slave radio). However, tuning and alignment information are not affected by cloning.

3.3 Parameters which are cloned

- Radio Wide parameters
- Channel settings
- VFO settings

3.4 Parameters which are not cloned

- All hardware tuning and alignment parameters.
- Unit Serial Number.

3.5 To Clone a Radio

Cloning duplicates the contents of your radio (master radio) into your customer's radio (slave radio). Tuning and alignment information are not affected by cloning.

1. Turn off both the master and slave radios (if any of them are turned on).
2. Connect both radios with the cloning cable through the Programming Port (lower port of the Accessory Connector).
3. Turn on the slave radio.
4. Press and hold the *A* button, and turn on the master radio.
5. The master radio displays **CLONE** if cloning can proceed, otherwise an error message is shown.
6. The slave radio displays **PROG** while it is being programmed.
7. When cloning is completed, the master radio displays **END**, and the slave radio resets automatically.
8. Disconnect radios from the cloning cable. They are now ready for operation.

3.6 Error Conditions

An error may occur when cloning a radio. When this happens, an error message is displayed. The following lists the causes and the possible solutions for each error message.

Error Message	Description
TIME OUT	Data communications time-out. Please ensure that the slave radio is switched on, and the cloning cable is properly connected.
BCC ERR	Data communications checksum error.
TYPE ERR	Mismatch in model numbers. Please ensure that the master and slave radios are of the same model number.
CMD ERR	Data communications command error.

3.7 Dealer and User Configurations

Your radio is shipped out from the factory configured according to the User Configuration. In this configuration, users can only access the channels that are preprogrammed by the dealer. Channels and other radio settings can **ONLY** be programmed when the radio is operating in Dealer Configuration.

To prepare radios for the users, the dealer should

1. Set the radio into Dealer Configuration (if the radio is configured in User Configuration).
2. Program the radio with all the necessary parameters, according to the users' requirements.
3. Set the radio back to User Configuration.
4. Clone the radio's parameters to all the users' radios.

3.7.1 Switching between Dealer and User Configurations

From Dealer to User

1. Turn off the radio.
2. Press PTT, the *Monitor* button and the + button together, and turn on the radio.
3. LCD displays **PROTECT**.
4. To confirm switching to User Configuration, press PTT. To cancel, press any other button.
5. Turn off the radio. The radio now operates in User Configuration.

From User to Dealer

1. Turn off the radio.
2. Press PTT, the *Monitor* button and the + button together, and turn on the radio.
3. LCD displays **PRO-CLR**.
4. To confirm switching to Dealer Configuration, press PTT. To cancel, press any other button.
5. Turn off the radio. The radio now operates in Dealer Configuration.

IMPORTANT: If the radio is to be given to the customer, **REMEMBER** to switch it back to operate in User Configuration.

4.0 Programming Mode

4.1 Introduction

This mode allows you to edit a number of features to enhance the use of this radio.

4.2 Entering Programming Mode

If the radio is turned on, turn it off. Press and hold the *MON*, and turn on the radio. A ringing tone is heard, which indicates that the radio is in Programming Mode. The ▭ indicator is displayed.

4.3 Exiting Programming Mode

To exit Programming Mode, turn off the radio.

4.4 Accessing Programming Mode Parameters

In Dealer Configuration, Programming Mode parameters are grouped into three main categories: RW (Radio Wide), Channel (001 to XXX[1]) and VFO (Variable Frequency Operation).

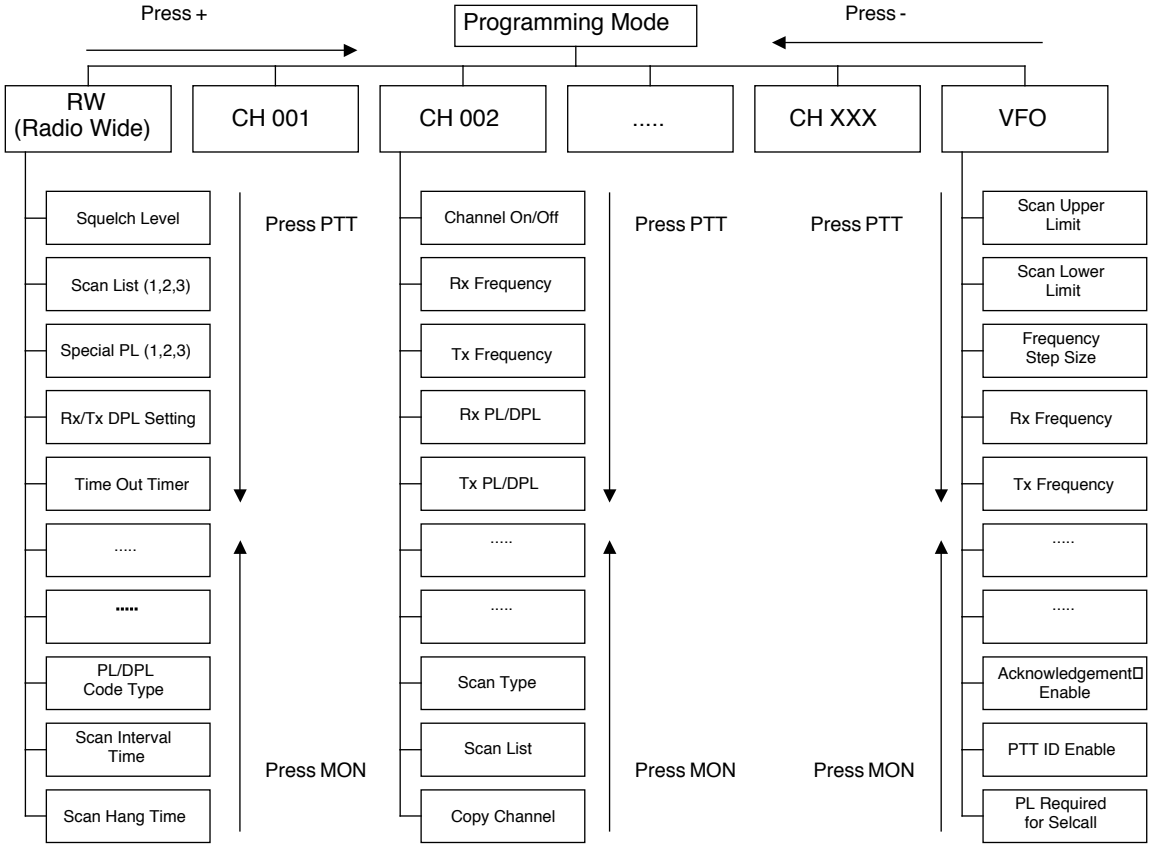
Use + or - buttons, to move from one category to another.

RW ←→ CH 001 ←→ CH 002 ←→ … ←→ CH XXX[1] ←→ VFO

NOTE: Radio operating in User Configuration is only restricted to RW parameters.

Once you have selected the category, and wish to view its parameters, use PTT or *MON* to move from one parameter to the other, as shown in the next diagram.

1. XXX denotes the maximum number of channels supported by your radio model.



4.5 Editing RW (Radio Wide) Parameters

Radio Wide parameters are common to the whole radio. They become effective after you press PTT or *MON*.

RW Parameter	Description	Range	Default from Factory	Remarks
SQL-XX	Squelch Level	SQL-00, …, SQL-15	model dependent	• Select low level when you need to receive very weak signal, and select high level when the communications distance is near, or your radio is receiving interference. • Press **+** or **-** to select the desired squelch level.

RW Parameter	Description	Range	Default from Factory	Remarks
SCANLST1	Scan List 1	1-01-XXX, …, 1-16-XXX, XXX denotes channel number.	1-01-001, 1-02-002, ..., 1-16-016	• Up to 16 members per scan list. First member is assigned as Priority Channel if Priority Scan is started. • When scanning is started, only these 16 members will be scanned. • Each channel can choose to use Scan List 1, 2 or 3. • By default, all your channels select Scan List 1. If there is special need to use the other two scan lists for some of your channels, please consult your dealer. • Press **+** and **-** to move from one scan list member to another. • To include a channel into the scan list, enter the desired channel number using the keypad. • To erase a channel number from the scan list, press **#**. • Refer to "4.10.3 Setting Up a Scan List" on page 21 for details.
SCANLST2	Scan List 2	2-01-XXX, …, 2-16-XXX		See Above.
SCANLST3	Scan List 3	3-01-XXX, …, 3-16-XXX		See Above.
PL1-XXX.X	Special PL Frequency 1	PL1-067.0, PL1-067.1, …, PL1-254.9, PL1-255.0		• You may program any PL frequency from 067.0 Hz to 255.0 Hz, with 0.1 Hz resolution. This PL can then be used as receive and/or transmit PL for VFO or any channel. • Up to three special PL frequencies are available. • Use the keypad to enter the PL frequency directly. • Out-of-bound PL frequency will not be accepted. A negative tone is heard when attempted.
PL2-XXX.X	Special PL Frequency 2	PL2-067.0, PL2-067.1, …, PL2-254.9, PL2-255.0		See above.
PL3-XXX.X	Special PL Frequency 3	PL3-067.0, PL3-067.1, …, PL3-254.9, PL3-255.0		See above.

RW Parameter	Description	Range	Default from Factory	Remarks
RDPL-XXX	Rx DPL Setting	RDPL-NOR, RDPL-INV	RDPL-NOR	• Select RDPL-NOR to use the DPL codes listed under "4.9 DPL Codes" on page 19. • Select RDPL-INV to invert the received DPL before decoding it. • Inverted coding allows for more traffic/usage on frequencies. • DPL Invert must be set on both receiving and transmitting radios for communication to occur.
TDPL-XXX	Tx DPL Setting	TDPL-NOR, TDPL-INV	TDPL-NOR	• Select TDPL-NOR to use the DPL codes listed under "4.9 DPL Codes" on page 19. • Select TDPL-INV to encode DPL by inverting all the bits in the chosen DPL code, before sending it.
TOT-XXX	Time Out Timer	TOT-OFF, TOT-001, …, TOT-010	TOT-001	• This determines the maximum duration that you can transmit continuously. • Press **+** or **-** to select the desired time out timer.
BS-XXXX	Battery Saver	BS-OFF, BS-NORM, BS-ENH	BS-ENH	• Battery Saver helps to extend your battery life. • When enabled, it turns off the radio receiver circuitry periodically when no activity is detected. • BS-NORM (Normal) turns off less frequently. Select this if you want to save battery and are expecting Selective Calls. • BS-ENH (Enhanced) turns off the receiver for a longer duration. Select this if you want to maximize battery saving, and do not expect to receive any Selective Call. • Press **+** or **-** to select the desired battery saver setting.
BT-XXXX	Battery Type	BT-NIMH, BT-NICD, BT-ALK	BT-NIMH	• Select the type of battery that your radio is using: NIMH (Nickel Metal Hydride), NICD (Nickel Cadmium) or ALK (Alkaline). • Press **+** or **-** to select the desired battery type. **NOTE:** Not all battery types are available at the time of printing. Please consult your dealer.
BEEP-X	Alert Tone Volume	BEEP-OFF, BEEP-1, BEEP-2, BEEP-3	BEEP-3	• Select the alert tone volume needed. Select BEEP-OFF if you require a quiet operation, or BEEP-3 if you are working in a noisy environment. • Press **+** or **-** to select the desired alert tone volume setting.
PRM-XXX	Prime Channel Select	PRM-OFF, PRM-001, …., PRM-YYY, YYY denotes the highest channel number supported by your model.	PRM-OFF	• Prime Channel is a channel that you wish to spend most of your time monitoring. • The radio always powers up in the Prime Channel, if it is programmed. • The radio will always switch back to the Prime Channel if it is idle longer than the Prime Channel Return Hang Time (programmable) in other channel. • Press **+** or **-** to select the desired channel number as Prime Channel.

RW Parameter	Description	Range	Default from Factory	Remarks
PRMT-XXX	Prime Channel Return Hang Time	PRMT-OFF, PRMT-001, ..., PRMT-015	PRMT-007	• This feature is only valid if a Prime Channel is programmed. • XXX denotes the time that the radio will stay idle in a non-Prime channel before switching back to the Prime channel. • Select OFF if you do not wish to switch to the Prime channel automatically. • Unit is in seconds. Prime Channel Return Hang Time is therefore programmable from 1 second to 15 seconds in increments of 1 second.
PID-XXXX	PTT ID Transmit Manner	PID-OFF, PID-PRE, PID-POST, PID-BOTH	PID-PRE	• Select how the PTT ID is transmitted: OFF (not transmitted), PRE (transmitted upon PTT press), POST (transmitted after PTT is released), BOTH (transmitted upon PTT press as well as after PTT is released). • Press **+** or **-** to select the desired PTT ID transmit manner. **NOTE:** PTT ID has to be enabled on a per channel basis to enable transmission.
ST-XXX	PTT ID Sidetone	ST-OFF, ST-ON	ST-ON	• When PTT ID Sidetone is enabled (ON), an alert tone is heard as soon as PTT is pressed, and when PTT ID is being sent. • Press **+** or **-** to select ON or OFF.
SST-XXX	PTT ID Short Sidetone	SST-OFF, SST-ON	SST-OFF	• When PTT ID short sidetone is enabled (ON), an alert tone is heard after PTT ID is sent. It indicates that the user is ready to start talking. • Press **+** or **-** to select ON or OFF.
PTM-XXXX	Tx Pretime	PTM-0000, PTM-0025, …., PTM-4000	PTM-0050	• Pretime is the duration from which PTT is pressed to the time when PTT ID is ready to be sent. • Adjust the pretime to suit the repeater's response time. • Unit is in ms. Pretime is therefore programmable from 0 ms to 4000 ms in 25 ms steps. • Press **+** or **-** to select the desired pretime.
LGT-XXXX	Backlight Select	LGT-AUTO, LGT-TOGL	LGT-AUTO	• Selecting LGT-TOGL causes the *Backlight* button to toggle the ON/OFF status of the LCD backlight. • Selecting LGT-AUTO causes the backlight to be turned off, if there is no keypress for more than 5 seconds. • Press **+** or **-** to select the desired backlight setting.
PTT-ID	PTT ID	8 characters consist of 1,2, …, 9, 0, A, B, C, D, *, # and Pause.	*Blank*	• PTT ID is sent when PTT is pressed. It serves as the identity of your radio. • Press **+** or **-** to move the cursor to the appropriate character. Use the keypad to enter the ID. *Pause* can be entered by pressing * followed by **#**. Enter **#** 8 times to erase ID. • Refer to "4.10.4 Programming an ID" on page 21 for details.

RW Parameter	Description	Range	Default from Factory	Remarks
IND ID	Individual ID	8 characters consist of 1,2, …, 9, 0, A, B, C, D, *, and #.	*Blank*	• IND ID is a unique ID for the radio. When the radio receives a Selcall which matches its IND ID, the radio is said to have received an Individual Call. A ringing tone will sound. If ACK ID is enabled and programmed, the ACK ID will be sent. • Press **+** or **-** to move the cursor to the appropriate character. Use the keypad to enter the ID. Enter **#** 8 times to erase ID. • Refer to "4.10.4 Programming an ID" on page 21 for details.
GROUP ID	Group ID	8 characters consist of 1,2, …, 9, 0, A, B, C, D, *, and #.	*Blank*	• GROUP ID is an ID for the group where the radio belongs. When the radio receives a Selcall which matches its GROUP ID, the radio is said to have received a Group Call. • Press **+** or **-** to move the cursor to the appropriate character. Use the keypad to enter the ID. Enter **#** 8 times to erase ID. • Refer to "4.10.4 Programming an ID" on page 21 for details.
ALL ID	All ID	8 characters consist of 1,2, …, 9, 0, A, B, C, D, *, and #.	*Blank*	• ALL ID is like an ID for all. When the radio receives a Selcall which matches its ALL ID, the radio is said to have received an All Call. • Press **+** or **-** to move the cursor to the appropriate character. Use the keypad to enter the ID. Enter **#** 8 times to erase ID. • Refer to "4.10.4 Programming an ID" on page 21 for details.
ACK ID	Acknowledgement ID	8 characters consist of 1,2, …, 9, 0, A, B, C, D, *, and #.	*Blank*	• ACK ID is sent when the radio receives an Individual Call and Acknowledgement is enabled. • Press **+** or **-** to move the cursor to the appropriate character. Use the keypad to enter the ID. Enter **#** 8 times to erase ID. • Refer to "4.10.4 Programming an ID" on page 21 for details.
ASP-XXXX	Button A Short Press Function	ASP-DISP, ASP-LGHT, ASP-LOCK, ASP-NDEL, ASP-NOP, ASP-OFS, ASP-PHN, ASP-PID, ASP-PL, ASP-PRM, ASP-PWR, ASP-SCAN, ASP-SQL, ASP-TA, ASP-VFO	ASP-PWR	• The four buttons (A, B, C and D) are programmable to meet the needs of the user. • The functions available include DISP (Channel Alias), LGHT (Backlight), LOCK (Keypad Lock), NDEL (Nuisance Channel Delete), NOP (No Operation), OFS (Offset Frequency), PHN (Phone Mode), PID (PTT ID Enable), PL (PL/DPL Enable), PRM (Prime Channel), PWR (Power Select), SCAN (Scan), SQL (Squelch Level), TA (Talkaround), VFO (VFO/Memory). • Press **+** or **-** to select the desired function for the button.

RW Parameter	Description	Range	Default from Factory	Remarks
ALP-XXXX	Button A Long Press Action	ALP-DISP, … (See above)	ALP-PID	See above.
BSP-XXXX	Button B Short Press Action	BSP-DISP, … (See above)	BSP-SQL	See above.
BLP-XXXX	Button B Long Press Action	BLP-DISP, … (See above)	BLP-PHN	See above.
CSP-XXXX	Button C Short Press Action	CSP-DISP, … (See above)	CSP-PL	See above.
CLP-XXXX	Button C Long Press Action	CLP-DISP, … (See above)	CLP-LOCK	See above.
DSP-XXXX	Button D Short Press Action	DSP-DISP, … (See above)	DSP-SCAN	See above.
DLP-XXXX	Button D Long Press Action	DLP-DISP, … (See above)	DLP-NDEL	See above.
AC CODE	Access Code	16 characters consist of 1,2, …, 9, 0, A, B, C, D, *, # and Pause.	*Blank*	• Access Code is dialed when you want to access the landline telephone network. • Once it is programmed, it can be sent by pressing PTT, followed by **+**, and then *****. • *Pause* can be entered by pressing ***** followed by **#**. • Enter **#** 16 times, to completely erase entered code. • Refer to "4.10.5 Programming an Phone Number/ Access Code/De-access Code" on page 22 for details.
DA CODE	De-access Code	16 characters consist of 1,2, …, 9, 0, A, B, C, D, *, # and Pause.	*Blank*	• De-access Code is dialed when you want to disconnect from the landline telephone network. • Once it is programmed, it can be sent by pressing PTT, followed by **+**, and then **#**. • *Pause* can be entered by pressing ***** followed by **#**. • Enter **#** 16 times, to completely erase entered code. • Refer to "4.10.5 Programming an Phone Number/ Access Code/De-access Code" on page 22 for details.

RW Parameter	Description	Range	Default from Factory	Remarks
TELNO-X	Telephone Number	16 characters consist of 1,2, …, 9, 0, A, B, C, D, *, # and Pause.	*Blank*	• Up to nine telephone numbers can be programmed. • Once programmed into the memory, phone number can be speed dialed by pressing PTT, **+** and then **X**, where **X** denotes the telephone number location. • *Pause* can be entered by pressing ***** followed by **#**. • Enter **#** 16 times, to completely erase entered code. • Refer to "4.10.5 Programming an Phone Number/ Access Code/De-access Code" on page 22 for details.
PL-XXXX	PL/DPL Display Type	PL-CODE, PL-FREQ	PL-FREQ	• Select the display type of PL/DPL: FREQ and CODE. • If FREQ has been selected, then the PL and DPL will be displayed in frequency and octal code format respectively. • If CODE has been selected, then the PL and DPL will be displayed in Motorola code number format (see "4.8 PL Frequencies and Codes" on page 18 and "4.9 DPL Codes" on page 19). • Press **+** or **-** to select CODE or FREQ.
SIT-XXXX	Scan Interval Time	SIT-0250, SIT-0500, ……, SIT-5000	SIT-0500	• Scan Interval Time is the duration the radio will spend on the landed channel before switching to scan the Priority Channel in Priority Scanning. • Unit is in ms. Scan Interval Time is therefore programmable from 250ms to 5000ms in 250ms steps. • Press **+** or **-** to select the desired Scan Interval Time.
SHT-XXXX	Scan Hang Time	SHT-0500, SHT-1000, ……, SHT-9500	SHT-7000	• Scan Hang Time is the duration the radio will stay on the landed channel without detecting any activity before it resumes scanning. • Unit is in ms. Scan Hang Time is therefore programmable from 500ms to 9500ms in 500ms steps. • Press **+** or **-** to select the desired Scan Hang Time.

4.6 Editing Channel Parameters

Channel parameters only affect the channel where the parameters are modified. They become effective after you press PTT or *MON*.

Channel Parameter	Description	Range	Default from Factory	Remarks
CH-XX	Channel On/ Off	CH-OFF, CH-ON	CH-ON	• Select if the channel is enabled (ON) or disabled (OFF). • Disabled channel will not be accessible in Normal Mode. • Press **+** or **-** to select ON or OFF.

Channel Parameter	Description	Range	Default from Factory	Remarks
RXXX.XXXX	Channel Receive Frequency	Within the band limits of your model	R136.0250	• This is the frequency that the channel will use to receive message. • You are not allowed to enter out-of-bounds frequencies. • Use the keypad to enter the frequency directly.
TXXX.XXXX	Channel Transmit Frequency	Within the band limits of your model	T136.0250	• This is the frequency that the channel will use to transmit message. • You are not allowed to enter out-of-bounds frequencies. • Use the keypad to enter the frequency directly.
RPL-XXXX	Channel Receive PL/DPL	When PL-FREQ is selected in RW: OFF, 067.0, …, 254.1, 023.D, 025.D, …,754.D, PL1, PL2, PL3 ***OR*** When PL-CODE is selected in RW: 000, 001, …, 126, PL1, PL2, PL3	RPL-OFF	• This is the PL or DPL code that the channel will use to unsquelch the receive message. • Two display formats are available: FREQ and CODE, selectable in RW. • OFF or 000 indicates that no PL/DPL is used for receive, i.e., radio operates in carrier squelch mode. • Press **+** or **-** to select the desired PL/DPL.
TPL-XXXX	Channel Transmit PL/DPL	When PL-FREQ is selected in RW: OFF, 067.0, …, 254.1, 023.D, 025.D, …,754.D, PL1, PL2, PL3 ***OR*** When PL-CODE is selected in RW: 000, 001, …, 126, PL1, PL2, PL3	TPL-OFF	• This is the PL or DPL code that the channel will use to transmit the message. • Two display formats are available: FREQ and CODE, selectable in RW. • OFF or 000 indicates that no PL/DPL is used for transmit. • Press **+** or **-** to select the desired PL/DPL.

Channel Parameter	Description	Range	Default from Factory	Remarks
TOC-XXX	Turn Off Code/ Reverse Burst	TOC-OFF, TOC-ON	TOC-ON	• TOC or Reverse Burst serves to cause the receiving radio to mute its speaker before a loss of carrier is detected. • If enabled (ON), Turn Off Code will be sent if Tx DPL is enabled for the channel (Reverse Burst for Tx PL). • Press **+** or **-** to select ON or OFF.
XXX-POWR	Power Level	HI-POWR, LOW-POWR, ECO-POWR, RX ONLY	HI-POWR	• Select the power level required for the channel. • HI-POWR transmits at the maximum tuned power. LOW-POWR is typically 1W and ECO-POWR, less than 500mW. Set to RX ONLY if the channel is intended as a Receive Only Channel. • Press **+** or **-** to select the desired Tx power level.
BCL-XXX	Busy Channel Lockout	BCL-OFF, BCL-ON	BCL-OFF	• Select if the channel is to enable Busy Channel Lockout (BCL). • If BCL is enabled, the channel will check for channel activity before you can transmit. Detection of channel activity which is not from the same group would prevent radio from transmitting. • Press **+** or **-** to select the desired BCL setting.
CH-TAG	Channel Alias	0,1,….,9, A, B, …., Z, +, -, /, *, #, Space.	*Blank*	• Allows the channel number to be displayed as alias. • Press **+** or **-** to move to the character that needs to be edited. Enter the character using the keypad. • Refer to "4.10.2 Entering a Channel Alias" on page 20 for details.
CS – XX.X	Channel Spacing	CS – 12.5, CS – 25.0	CS – 25.0	• Select the channel spacing for the channel. • Press **+** or **-** to select the desired channel spacing.
SC-XXX	Selective Call (Selcall)	SC-OFF, SC-ON	SC-OFF	• Select if Selcall is to be enabled or disabled. • If enabled, the channel would adopt Signaling Squelch Mode, i.e., unsquelch only if radio is receiving carrier AND Selcall (matching ID). • Press **+** or **-** to select the desired Selcall setting.
ACK-XXX	Acknowledgement Enabled for Individual Call	ACK-OFF, ACK-ON	ACK-OFF	• Select if Acknowledgement is to be sent upon receiving an Individual Call. • If enabled, the preprogrammed Ack ID will be replied once the Individual Call is received and carrier loss is detected. • Press **+** or **-** to select the desired acknowledgement setting.
PID-XXX	PTT ID	PID-OFF, PID-ON	PID-OFF	• Select if PTT ID is to be sent upon PTT press. • If enabled, PTT ID would be sent according to the PTT ID Transmit Type selected in RW. • Press **+** or **-** to select the desired PTT ID transmit setting.

Channel Parameter	Description	Range	Default from Factory	Remarks
SCPL-XXX	PL Required for Selcall	SCPL-OFF, SCPL-ON	SCPL-OFF	• Select if the channel Rx PL/DPL is required for qualifying the incoming Selcall. • If enabled, incoming Selcall would be checked for matching Rx PL/DPL before radio would unsquelch. • Press **+** or **-** to select the desired setting.
SCN-XXXX	Scan Type	SCN-NORM, SCN-PRTY	SCN-NORM	• Select the type of scan to be started if *Scan* button is pressed. • Two types of scan are available: Normal (NORM) and Priority (PRTY). • Press **+** or **-** to select the desired scan type.
SCN-LSTX	Scan List	SCN-LST1, SCN-LST2, SCN-LST3	SCN-LST1	• Select the scan list to be used by the channel. • Press **+** or **-** to select the desired scan list.
CH-COPY	Copy Channel	C-01-XXX, C-02-XXX, …, C-16-XXX	*N/A*	• Allows the same channel parameters to be copied to up to 16 channels at one time. • Press **+** or **-** to move to the channel holder and then enter the channel number using the keypad. • Refer to "4.10.1 Copying All Parameters from One Channel to Other Channel(s)" on page 20 for details.

4.7 Editing VFO Parameters

VFO parameters are only valid when VFO is in use. They become active after you press PTT or *MON*.

Channel Parameter	Description	Range	Default from Factory	Remarks
UXXX.XXXX	VFO Scan Upper Limit	Within the band limits of your model	U174.0000	• This is the upper-most frequency that VFO will scan. • You are not allowed to enter out-of-bound frequencies. • Use the keypad to enter the frequency directly.
LXXX.XXXX	VFO Scan Lower Limit	Within the band limits of your model	L136.0000	• This is the lowest frequency that VFO will scan. • You are not allowed to enter out-of-bound frequencies. • Use the keypad to enter the frequency directly.
STEP XXX	Frequency Step Size	STEP 5, STEP 625, STEP 10, STEP 12.5, STEP 15, STEP 20, STEP 25	STEP 5	• Select the appropriate frequency step size for Rx/Tx frequency entry. • This step size will dictate the increment or decrement size when **+** or **-** is pressed in VFO. • VFO scan will also use this step size to scan the frequency band. Available step sizes are 5, 6.25, 10, 12.5, 15, 20 and 25 kHz. • Press **+** or **-** to select the desired frequency step size.

Channel Parameter	Description	Range	Default from Factory	Remarks
RXXX.XXXX	VFO Receive Frequency	Within the band limits of your model	R136.0000	• This is the frequency the VFO uses to receive messages. • You are not allowed to enter out-of-bound frequencies. • Use the keypad to enter the frequency directly.
TXXX.XXXX	VFO Transmit Frequency	Within the band limits of your model	T136.0000	• This is the frequency the VFO uses to transmit messages, when repeater offset is set to OFS-PROG (User Defined Tx Frequency). • You are not allowed to enter out-of-bound frequencies. • Use the keypad to enter the frequency directly.
OFS-XXX	Repeater Offset Frequency	OFS 000, OFS 001, …., OFS 100.	OFS 006 (VHF), OFS 050 (UHF)	• Select the repeater offset frequency to be used. • When repeater offset is set to OFS-POS, this offset frequency will be added to the VFO Rx frequency to transmit messages. • When repeater offset is set to OFS-NEG, this offset frequency will be deducted from the VFO Rx frequency to transmit messages. • Unit is in 100kHz. Repeater offset frequency therefore ranges from 0kHz to 10MHz in the increment of 100kHz. • Press **+** or **-** to select the desired repeater offset frequency.
RPT-XXXX	Repeater Offset	RPT-OFF, RPT-POS, RPT-NEG, RPT-PROG	RPT-OFF	• Selects the repeater offset to be used. • Select OFF if Tx frequency equals Rx frequency. • Select POS if Tx frequency is the sum of Rx frequency and the offset frequency. • Select NEG if Tx frequency is the difference of Rx frequency and the offset frequency. • Select PROG if Tx frequency equals the User Defined Tx frequency. • Press **+** or **-** to select the desired repeater offset.

Channel Parameter	Description	Range	Default from Factory	Remarks
RPL-XXXX	Channel Receive PL/ DPL	When PL-FREQ is selected in RW: OFF, 067.0, …, 254.1, 023.D, 025.D, …,754.D, PL1, PL2, PL3 ***OR*** When PL-CODE is selected in RW: 000, 001, …, 126, PL1, PL2, PL3	RPL-OFF	• This is the PL or DPL code that the VFO will use to unsquelch the receive message. • Two display formats are available: FREQ and CODE, selectable in RW. • OFF or 000 indicates that no PL/DPL is used for receive, i.e., radio operates in carrier squelch mode. • Press **+** or **-** to select the desired PL/DPL.
TPL-XXXX	Channel Transmit PL/ DPL	When PL-FREQ is selected in RW: OFF, 067.0, …, 254.1, 023.D, 025.D, …,754.D, PL1, PL2, PL3 ***OR*** When PL-CODE is selected in RW: 000, 001, …, 126, PL1, PL2, PL3	TPL-OFF	• This is the PL or DPL code that the VFO will use to transmit the message. • Two display formats are available: FREQ and CODE, selectable in RW. • OFF or 000 indicates that no PL/DPL is used for transmit. • Press **+** or **-** to select the desired PL/DPL.
TOC-XXX	Turn Off Code/ Reverse Burst	TOC-OFF, TOC-ON	TOC-ON	• TOC or Reverse Burst serves to cause the receiving radio to mute its speaker before a loss of carrier is detected. • If enabled (ON), Turn Off Code will be sent if Tx DPL is enabled for the channel (Reverse Burst for Tx PL). • Press **+** or **-** to select ON or OFF.

Channel Parameter	Description	Range	Default from Factory	Remarks
XXX-POWR	Power Level	HI-POWR, LOW-POWR, ECO-POWR, RX ONLY	HI-POWR	• Select the power level required for the channel. • HI-POWR transmits at the maximum tuned power. LOW-POWR is typically 1W and ECO-POWR, less than 500mW. Set to RX ONLY if the channel is intended as a Receive Only Channel. • Press **+** or **-** to select the desired Tx power level.
BCL-XXX	Busy Channel Lockout	BCL-OFF, BCL-ON	BCL-OFF	• Select if the VFO is to enable Busy Channel Lockout (BCL). • If BCL is enabled, the VFO will check for activity before you can transmit. Detection of activity which is not from the same group would prevent radio from transmitting. • Press **+** or **-** to select the desired BCL setting.
CS – XX.X	Channel Spacing	CS – 12.5, CS – 25.0	CS – 25.0	• Select the channel spacing for the VFO. • Press **+** or **-** to select the desired channel spacing.
SC-XXX	Selective Call (Selcall)	SC-OFF, SC-ON	SC-OFF	• Select if Selcall is to be enabled or disabled. • If enabled, the VFO would adopt Signaling Squelch Mode, i.e., unsquelch only if radio is receiving carrier AND Selcall (matching ID). • Press **+** or **-** to select the desired Selcall setting.
ACK-XXX	Acknowledgement Enabled for Individual Call	ACK-OFF, ACK-ON	ACK-OFF	• Select if Acknowledgement is to be sent upon receiving an Individual Call. • If enabled, the preprogrammed Ack ID will be replied once the Individual Call is received and carrier loss is detected. • Press **+** or **-** to select the desired acknowledgement setting.
PID-XXX	PTT ID	PID-OFF, PID-ON	PID-OFF	• Select if PTT ID is to be sent upon PTT press. • If enabled, PTT ID would be sent according to the PTT ID Transmit Type selected in RW. • Press **+** or **-** to select the desired PTT ID transmit setting.
SCPL-XXX	PL Required for Selcall	SCPL-OFF, SCPL-ON	SCPL-OFF	• Select if the VFO Rx PL/DPL is required for qualifying the incoming Selcall. • If enabled, incoming Selcall would be checked for matching Rx PL/DPL before radio would unsquelch. • Press **+** or **-** to select the desired setting.

4.8 PL Frequencies and Codes

PL Freq (Hz)	Motorola Code	Equiv. PL Code		PL Freq (Hz)	Motorola Code	Equiv. PL Code
67	001	XZ		136.5	022	4Z
69.3	002	WZ		141.3	023	4A
71.9	003	XA		146.2	024	4B
74.4	004	WA		151.4	025	5Z
77	005	XB		156.7	026	5A
79.7	006	WB		162.2	027	5B
82.5	007	YZ		167.9	028	6Z
85.4	008	YA		173.8	029	6A
88.5	009	YB		179.9	030	6B
91.5	010	ZZ		186.2	031	7Z
94.8	011	ZA		192.8	032	7A
97.4	012	ZB		203.5	033	M1
100	013	1Z		206.5	034	8Z
103.5	014	1A		210.7	035	M2
107.2	015	1B		218.1	036	M3
110.9	016	2Z		225.7	037	M4
114.8	017	2A		229.1	038	9Z
118.8	018	2B		233.6	039	M5
123	019	3Z		241.8	040	M6
127.3	020	3A		250.3	041	M7
131.8	021	3B		254.1	042	0Z
				PL1	PL1	
				PL2	PL2	
				PL3	PL3	

NOTE: PL1, PL2, PL3 are the User Defined PL Frequencies.

4.9 DPL Codes

DPL Code	Motorola Code	DPL Code	Motorola Code	DPL Code	Motorola Code	DPL Code	Motorola Code
23	043	152	065	343	087	606	109
25	044	155	066	346	088	612	110
26	045	156	067	351	089	624	111
31	046	162	068	364	090	627	112
32	047	165	069	365	091	631	113
43	048	172	070	371	092	632	114
47	049	174	071	411	093	645*	115
51	050	205	072	412	094	654	116
54	051	223	073	413	095	662	117
65	052	226	074	423	096	664	118
71	053	243	075	431	097	703	119
72	054	244	076	432	098	712	120
73	055	245	077	445	099	723	121
74	056	251	078	464	100	731	122
114	057	261	079	465	101	732	123
115	058	263	080	466	102	734	124
116	059	265	081	503	103	743	125
125	060	271	082	506	104	754	126
131	061	306	083	516	105		
132	062	311	084	532	106		
134	063	315	085	546	107		
143	064	331	086	565	108		

NOTE: The codes marked with an asterisk are not part of the 83 standard EIA/TIA-603 codes.

4.10 Examples

4.10.1 Copying All Parameters from One Channel to Other Channel(s)

Scenario: To copy the parameters in Channel 005 into the following channels - 029, 032, 045, 089

Steps:

1. Enter Programming Mode, by pressing *MON* and turning on the radio.
2. Press **+** or **-** to select **CH 005**.
3. Press PTT or *MON* until **CH-COPY** is displayed.
4. Press **+**. The first channel holder, **C-01-,** will be displayed. Use the keypad to enter **029**.
5. Press **+** again**.** When **C-02-** appears, use the keypad to enter **032**. Repeat this step for channels **045** and **089**.

   NOTE: If a mistake is made, use **+** or **-** to move to the appropriate channel holder and press **#** to erase the channel number.

6. Press PTT or *MON,* when all the channel numbers have been entered. Radio will display **COPY OK**.
7. Press **+** to confirm channel duplication or **-** to exit without duplication.
8. Turn off your radio, if you have completed the programming, or proceed to the next parameter.

4.10.2 Entering a Channel Alias

Scenario: To give Channel 028 an alias *SECURITY.*

Steps:

1. Enter Programming Mode, by pressing *MON* and turning on the radio.
2. Press **+** or **-** until **CH 028** is displayed.
3. Press PTT or *MON* until **CH TAG** is displayed.
4. Press **+**. The cursor will be placed on the first character.
5. Press *7* five times. The display will change from **7** -> **P** -> **Q** -> **R** -> **S**.
6. Use the table below to enter the other characters.
7. Press PTT or *MON,* after the last character has been entered.
8. Turn off your radio, if you have completed the programming, or proceed to the next parameter.

Keypad Button	1st Press	2nd Press	3rd Press	4th Press	5th Press	6th Press	7th Press
1	1						
2	2	A	B	C			
3	3	D	E	F			
4	4	G	H	I			
5	5	J	K	L			

Keypad Button	1st Press	2nd Press	3rd Press	4th Press	5th Press	6th Press	7th Press
6	6	M	N	O			
7	7	P	Q	R	S		
8	8	T	U	V			
9	9	W	X	Y	Z		
0	0	+	-	/	*	#	SPACE

4.10.3 Setting Up a Scan List

Scenario: To setup Scan List 2 with the following channels - CH 008, CH 036, CH 092, CH 083, CH 068.

Steps:

1. Enter Programming Mode, by pressing *MON* and turning on the radio.
2. Press **+** or **-** until **RW** is displayed.
3. Press PTT or *MON* until **SCANLST2** is displayed.
4. Press **+**. The first scan list member holder, **2-01-**, will be displayed. Use the keypad to enter 008.
5. Press **+** again. Enter 036, when **2-02-** appears, and subsequently in this manner, enter the other channels.

NOTE: If a mistake is made, use **+** or **-** to move to the appropriate scan list member holder and press **#** to erase the channel number.

6. Press PTT or *MON*, when all the channel numbers have been entered.
7. Turn off your radio, if you have completed the programming, or proceed to the next parameter.

4.10.4 Programming an ID

Scenario: To program PTT ID with the value “A1018”.

Steps:

1. Enter Programming Mode, by pressing *MON* and turning on the radio.
2. Press **+** or **-** until **RW** is displayed.
3. Press PTT or *MON* until **PTT-ID** is displayed.
4. Press **+**. The cursor will be placed on the first character.
5. Use the keypad and the programmable buttons to enter **A1018**.

NOTE: If a mistake is made, use **+** or **-** to move to the appropriate location and then re-enter the correct character. To erase the complete ID, enter **#** 8 times.

6. Press PTT or *MON*, when the complete ID has been entered.
7. Turn off your radio, if you have completed the programming, or proceed to the next parameter.

4.10.5 Programming an Phone Number/Access Code/De-access Code

Scenario: To program the phone number, 9-72886338 (where "-" represents a Pause digit), at memory location 8.

Steps:

1. Enter Programming Mode, by pressing *MON* and turning on the radio.
2. Press **+** or **-** until **RW** is displayed.
3. Press PTT or *MON* until **TELNO-8** is displayed.
4. Press **+**. The cursor will be placed on the first character.
5. Use the keypad to enter **9**.
6. Enter a Pause digit, by entering ***** followed by **#**. These two characters will be converted into a Pause, represented by '-'.

   NOTE: Each Pause digit entered shortens the overall length of the code/number by a digit.

7. Use the keypad to enter the rest of the phone number.

   NOTE: If a mistake is made, use **+** or **-** to move to the appropriate location and then re-enter the correct character. To erase the complete phone number/code, enter **#** 16 times.

8. Press PTT or *MON*, when the complete phone number has been entered.
9. Turn off your radio, if you have completed the programming, or proceed to the next parameter.

4.11 Factory Reset

This feature allows you to erase certain programmable parameters and restore the radio to the factory default settings. The radio, upon reset, clears all memory channels, phone numbers, and restores the default settings of RW parameters.

1. Set the radio in Dealer Configuration (if it is operating in User Configuration).
2. Press and hold **–** and *MON* together, while turning on the radio. LCD displays **INIT OK**.
3. Press PTT to confirm factory reset, or turn off the radio to exit.

   NOTE: When factory reset is in progress, LCD displays **INITIAL** for one second. When factory reset is completed, radio turns itself off, and back on again. The radio is now restored to its default factory settings.

Section 5

ERROR CODE DISPLAYS

1.0 Error Codes

The radio performs cursory tests to determine if its basic electronics and software are in working order, during start-up and during operations. Problems detected during these tests are presented as error codes on the radio display. The presence of an error code should prompt the user that a problem exists and that a service technician should be contacted. Use the following table to aid in understanding particular error code displays.

Table 5-1 Error Codes

Failure Display	Description
MEM ERR	Defective ROM.
EEP ERR	Defective external EEPROM. Codeplug data is corrupted.
PLL ERR	The radio cannot receive or transmit on the programmed frequencies.

This page is intentionally left blank.

Section 6
ACCESSORIES

1.0 Antennas

PMAD4027_	15cm Antenna, 136-155MHz
PMAD4028_	15cm Antenna, 148-174MHz
PMAD4012_	9cm Antenna, 136-155MHz
PMAD4013_	9cm Antenna, 155-174MHz
PMAD4014_	14cm Antenna, 136-155MHz
PMAD4015_	14cm Antenna, 155-174MHz
HLN8262_	External Antenna Adapter (BNC connector)

2.0 Carrying Accessories

4285820Z01	Shoulder Strap
HLN9844_	Belt Clip (1.5")
RLN4815_	Universal RadioPak Carry Case
HLN9985_	Waterproof Bag
JMZN4020_	Hand-strap for radio

3.0 Carry Cases

PMLN4467_	Carrying Case, Soft Leather Black
PMLN4468_	Carrying Holster Case, Neoprene Grey
PMLN4469_	Carrying Holster Case, Neoprene Blue

4.0 Chargers

PMTN4047_	Std Wall Charger (16hr), 230V, EU 2pin
PMTN4052_	Wall Charger (16hr), 230V, UK 3pin
PMTN4053_	Wall Charger (16hr), 110V, US 2pin
PMTN4049_	Rapid Charger 230V, EU 2 pin
PMTN4050_	Rapid Charger 240V, UK 3 pin
PMTN4048_	Rapid Charger 110V, US 2 pin

5.0 Batteries

PMNN4046_R	Battery Std NiMH with Belt Clip

6.0 Audio Accessories

PMLN4442_	MAG ONE Earbud with in-line PTT/MIC/Vox Switch
PMLN4443_	MAG ONE Ear Receiver with in-line PTT/MIC/Vox Switch
PMLN4444_	MAG ONE Earset Boom Mic with in-line PTT/Vox Switch
PMLN4445_	MAG ONE Ultra-lightweight Headset with in-line PTT/Vox
PMMN4008_	MAG ONE Remote Speaker Mic
HMN9030_	Remote Speaker Microphone
PMLN4294_	Ear Set Microphone with PTT
PMLN4425_	Earset Boom Mic with remote Ring PTT

7.0 Manuals

6804112J32	GP2000 User Guide (English)
6804112J49	GP2000 User Guide (Mandarin)
6804112J41	GP2000 Service Manual

8.0 Service Kits

PMVN4059_	Alpha Series Radio CPS Installation Kit (Disk)
PMVN4061_	Alpha Series Radio CPS Installation Kit (CD)
PMVN4060_	Tuner Installation Kit (Disk)
PMVN4062_	Tuner Installation Kit (CD)

This page is intentionally left blank.

Section 7

VHF BAND INFORMATION (136-174 MHZ)

1.0 Model Chart

VHF, 136-174 MHz			
Model			Description
AZH49KDH8AA9			GP2000, 136-174, 5W, 12.5/25K-99ch
	AZH49KDH8AA9		GP2000, 136-174, 5W, 12.5/25K-99ch (SKD model)
		Item	Description
X	X	PMUD1738_	GP2000, 136-174, 1/5W, 12.5/25K
X	X	PMUD1739_	GP2000, 136-174, 1/5W, 12.5/25K DT
X	X	DS1M001110	Front Cover Kit
X		DS1M001120	Chassis Hardware Kit
X	X	DS1M001130	Knob Assembly
X		DS1M001140	Ext. Cover Kit
X		DS1M001150	Controller Board Assembly
X		DS1M001160	RF Board Assembly
X		DS1M001170	LCD Kit
X		DS1M001180	Label Kit
X		DS1M001190	Speaker Assembly
X	X	DSM1B26051	Screw M2.6
X		DSM2192004	Contact Gasket
X	X	DSM2192005	Main Gasket
X	X	DSM2192006	Volume Gasket
X	X	DSM4193013	Gasket (Screw 26)
X		DSM5190001	Housing, Back
X	X	DSM6189003	PTT Button
	X	DS1M001200	Back Chassis Kit
X	X	PMAD4027_	15cm Antenna, 136-155M
X	X	PMAD4028_	15cm Antenna, 148-174M
X	X	PMAD4014	VHF, 14cm (136-155 MHz)
X	X	PMAD4015	VHF, 14cm (155-174 MHz)
X	X	PMAD4012	VHF, Stubby (136-155 MHz)
X	X	PMAD4013	VHF, Stubby (155-174 MHz)
X	X	PMTN4047_	Standard Wall Charger (16hr), 230V, EU 2pin

x = Indicates one of each is required.

VHF, 136-174 MHz			
Model			Description
X		6804112J32	GP2000 User Guide (English)
	X	6804112J49	GP2000 User Guide (Chinese)

x = Indicates one of each is required.

2.0 Specifications

General

	VHF	
Frequency:	136-174 MHz	
Channel Capacity:	99	
Power Supply:	7.5 Volts ±20%	
Dimensions with Standard High Capacity NiMH Battery:	113.5mm x 56mm x 35mm	
Weight: with Standard High Capacity NiMH Battery:	350 g	
Average Battery Life @ (5-5-90 Duty Cycle)	**(Low Power)** >11 hrs	**(High Power)** >8 hrs
Sealing:	Passes rain testing per IPX4 (EN60529=1991)	
Shock and Vibration:	Diecast with impact resistant polycarbonate housing passes EIA RS-316B	
Dust and Humidity:	Weather resistant housing passes EIA RS-316B	

Transmitter

	VHF	
RF Output NiMH @ 7.5V:	Low 1W	High 5W
Channel Spacing	12.5/25 kHz	
Freq. Stability (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-26 dBm	
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	40 dB	

Receiver

	VHF 12.5kHz	VHF 25kHz
Sensitivity 12dB SINAD:	0.25 μV	0.25 μV
Adjacent Channel Selectivity EIA	60 dB	65 dB
Intermodulation	60 dB	65 dB
Spur Rejection:	60 dB	65 dB
Image Rejection:	60 dB	65 dB
Hum and Noise	40 dB	
Audio Distortion	< 5%	
Conducted Emmision	-57 dBm	
Audio Output @ <5% Distortion	500 mW	500 mW

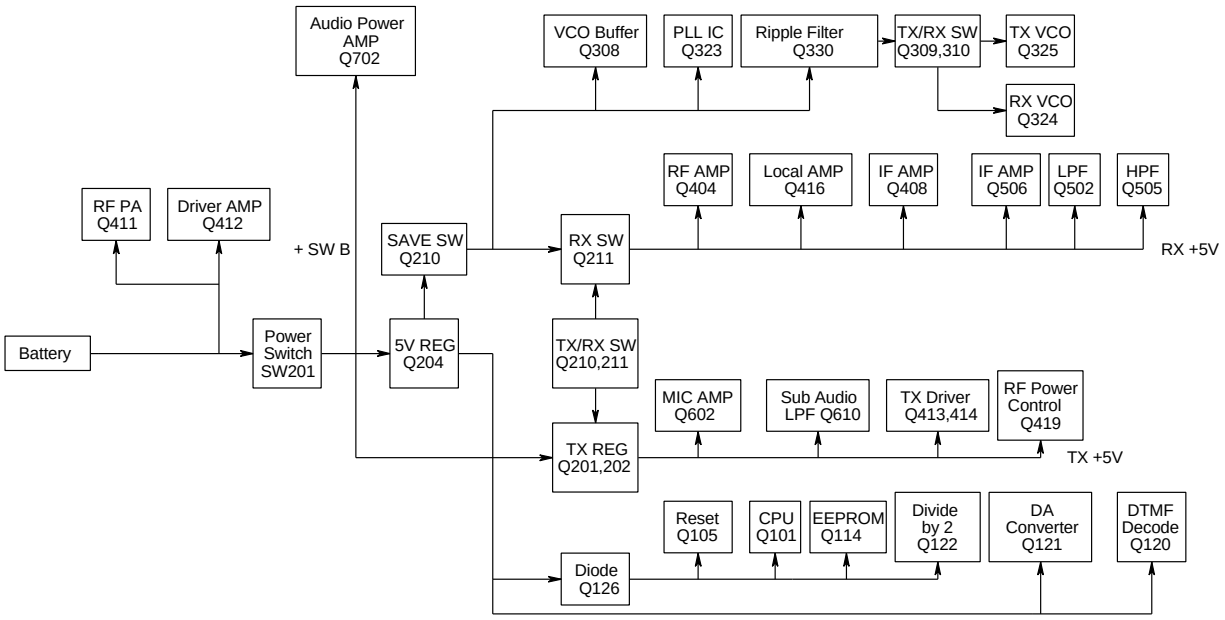
All specifications are subject to change without notice.

3.0 Theory of Operation

3.1 General Information

Your radio has two printed circuit boards: the Controller board, and the Radio Frequency (RF) board. The Controller board contains the CPU/Control section. The RF board contains the VCO/ Synthesizer section, Transmitter section, Receiver section, Transmitter Audio circuitry, Receiver Audio circuitry, and Battery section.

3.2 Power Distribution



The above figure illustrates the DC distribution throughout the radio board. A battery supplies power directly to the electronic on/off control. Radio power supply is triggered by the **Power Switch** (On/ Off/Volume control) and **+SW B** is distributed as show in the figure. Regulator output 5V is supplied to the CPU. **+SW B** continues to support the Audio Power AMP, 5V Regulator, TX Regulator until the radio is turned off.

The radio can be turned off on two ways:

1. **Power Switch** turned-off
2. Low Battery

When a low battery level is detected by the CPU, it stores the radio personality data to EEPROM before turning off the radio.

3.3 Power up Sequence

1. Power supply is turned on by the On/Off/Volume Control (Power Switch).
2. Power from battery is supplied to the regulator through the switch.
3. Output (5V) from the regulator is directed to the CPU (Q101).
4. Q105 resets the CPU (Q101).
5. The CPU loads radio personality data from EEPROM after the reset.

6. This personality data is used to initialize the radio.
7. The radio restores last power up state (i.e. state before the radio was turned-off).
8. Power is supplied to PLL circuitry.
9. Power is supplied to Rx and Rx VCO circuitry.
10. CPU sends data to PLL circuitry. If LOCK status is confirmed, radio continues the power-up sequence. Otherwise, PLL ERR is displayed.
11. If the Rx audio level is less than the pre-programmed squelch level, and other unmuting conditions are met, the radio will open squelch.

3.4 CPU / Control Section

When the radio is turned ON, the CPU (**Q101**) reads the radio status from the EEPROM **Q114**. It also monitors the keypad, the PTT line and other inputs such as the squelch detect, etc. continuously. When there is a channel change, the CPU sends the correct frequency information to the synthesizer via pins 2, 87 and 100. The CPU is clocked by the 8.388608MHz oscillator, which is composed of **X101**, **C101**, **C106**, and **R158**.

3.5 VCO / Synthesizer Section

This section consists of the Temperature-Compensated Crystal Oscillator(TCXO), Voltage Controlled Oscillator(VCO), Synthesizer and the Loop Filter. These circuits are found on the RF board.

3.5.1 Temperature-Compensated Crystal Oscillator (TCXO)

The reference oscillator is a temperature compensated crystal-controlled, Pierce type circuit. It utilizes a logic gate within **Q323** as a gain element. **C335** is used to adjust the oscillator on frequency (14.4MHz) at room temperature (22˚C). Temperature variations cause resistance changes in thermistor **R330** and **R567**, which is on the base of **Q320**, thus varying the voltage applied to varactor **Q322**. This changes the impedance across crystal **X301** in a manner complementary to the temperature drift characteristic of the crystal. In this way, the reference oscillator is held within the specified ±2.5 PPM from -30 to +60˚C.

3.5.2 Voltage-Controlled Oscillators

Only one of the VCOs runs at a time, which is controlled by **Q310** and **Q101**. The receive VCO consists of **C344-C351**, **L302**, **L305**, **L306**, **L312-L314**, **Q311**, and **Q324**. This VCO oscillates at 45.1 MHz above the programmed receive frequency. The VCO's oscillating frequency is tuned by the varactor **Q311**. The tuning voltage is supplied from the output of the Loop Filter. The output of the VCO is AC coupled (C352) to the synthesizer and the output buffer Q308 respectively. The output of the VCO buffer Q308 is AC coupled (**C475** and **R422-R444**, **C312**, **C313**) to the synthesizer and the output buffer **Q416** respectively.

When the PTT is pressed, **Q101** pin36 goes low (approx. 0V) disabling the receive VCO by the **Q310** and biases on **Q309** to enable the transmitter VCO. The transmitter VCO consists of **C353**, **C355**, **C357**, **C358**, **L315**, **L317**, **L318**, **Q325**, **Q326**, **Q329**, and **Q342**. This VCO oscillates on the programmed transmit frequency. The VCO's oscillating frequency is tuned by the varactor **Q326**. The tuning voltage is supplied from the output of the Loop Filter. The transmit voltage controlled oscillator is directly frequency-modulated and operates on the carrier frequency. The synthesizer is tuned in 5.00kHz or 6.25kHz steps.

3.5.3 Synthesizer

The frequency synthesizer is a large-scale monolithic synthesizer integrated circuit **Q323**. The synthesizer IC contains a dual modulus prescaler, programmable divide-by-N counter, prescale control (swallow) counter, reference oscillator, reference divider, phase detector, charge pump and lock detector. Also, included in **Q323** are shift registers and control circuits for frequency controls and general device control.

RF output from the active VCO is AC coupled to the synthesizer **Q323** prescaler input at Pin 8. The divide counter chain in **Q323**, consisting of the dual-modulus prescaler, swallow counter and programmable counter, divides the VCO signal down to a frequency very close to 5.00kHz or 6.25kHz which is applied to the phase detector. The phase comparator compares the phase with the 5.00kHz or 6.25kHz reference signal from the reference divider and drives the external charge pump (**Q314**, **Q315** and **Q301**). The synthesizer unlock detector circuit prevents the operation of the transmitter and receiver, when the phase lock loop (PLL) is unlocked. The following discussion assumes the unit has been placed in the transmit mode. **Q323** lock detector Pin 7 goes high when the PLL is locked. This high level is applied to Pin 25 of the CPU **Q101**. A software timing routing brings the RX/TX line low (Pin 36 of **Q101**). With the RX/TX line goes low, **Q209** is cut off and **Q208** is biased on passing **+5VTX-B** to **Q202**; it biases on **Q201** to pass switched **TX-B** to the transmitter amplifier string which enables transmission.

When the PLL is unlocked, the lock detector at **Q323** Pin 7 will begin pulsing low. A RC circuit converts this low pulse to a low level for the CPU. The CPU then changes the RX/TX line to a high, thus signaling the other transistor switches to drive **Q201** into cutoff, which disables transmission. Therefore, the transmitter remains disabled while the loop remains out of lock, and "PLL ERR" is displayed.

3.5.4 Loop Filter

The Loop Filter, a passive lead-lag filter consisting of **R314**-**R317**, **R356**, **C371**, **C323**, and **C369**, integrates the charge pump output to produce the DC turning voltage for the VCO. One parasitic pole, consisting of RF chokes **L306**/**L318**, prevent modulation of the VCOs by the 5.00kHz or 6.25kHz reference energy remaining at the output of the loop filter. Direct FM is obtained for modulating frequencies outside the PLL bandwidth by applying the CTCSS/DCS signals and the pre-emphasized, limited microphone audio to the VCO modulation circuit. The modulation circuit consists of **R347** and **Q329**.

3.6 Transmitter Section

3.6.1 RF Power Amplifier

After the PTT is pressed, the **+5VTX-B** line switches to approximately 5V. **Q309** is turned on, enabling transmit VCO. The VCO buffer, pre-driver, driver and power amplifier are biased on by **Q201**. **Q201** is biased on by the **+5VTX-B** line switching to 5V. RF output from the transmit VCO(**Q325**) is applied to the VCO output buffer **Q308**. Output from **Q308** feeds the buffer **Q414**. The output signal from **Q414** feeds the pre-driver amplifier **Q413**, and feeds the driver amplifier **Q412**, whose output from the driver stage feeds the final RF power amplifier **Q411** to produce the rated output power of 5 watts. The final output is feed to a low-pass filter (**C446**-**C448**, **C451**, **C452**, **L418**, and **L419**) and then to the transmit/receive switch **Q410**. RF power is then fed to the antenna via the output low-pass filter consisting of **C440**-**C445**, **L415**, and **L416**.

3.6.2 Antenna Switching

Switching of the antenna between the transmitter and the receiver is accomplished by the antenna transmit/receive switch consisting of diodes **Q409** and **Q410**. In the transmit mode, switched **TX B+** is applied through **R419** and RF choke **L417**, hard forward biasing the two diodes on **Q410**, thus permiting the flow of RF power from the output of the low-pass filter. **L414** and **C445** isolate the receiver circuit from the transmitter power input.

3.6.3 Power Control

Output power is controlled by the CPU (**Q101**), the D/A converter (**Q121**), the dual Op-Amp (**Q419**), which is used as a differential amplifier and comparator. Current is sensed by the voltage drop across **R445**. When the radio is in high power mode, this voltage is compared to the D/A converter voltage at 5-watt. When the radio is in low power mode, this voltage is compared to the D/A converter voltage at 1-watt. The power output is then reduced or increased by varying the applied voltage to the gate of the power amplifier **Q411** and **Q412**.

3.6.4 Transmitter Audio Circuits

The transmitter audio circuits consist of the audio processing circuits, the CTCSS circuits and the DCS circuits.

3.6.4.1 Audio Processing

Transmit speech audio is provided by either the internal electric microphone **M101** or the external microphone. The audio is pre-emphasized by 6dB per octave by **C615** and **R655**, and then its signal is amplified. The microphone audio is directed to amplifier **Q602B**, **Q602A** and low-pass filter **Q602C** and **Q602D**. **Q602A** has limiting function. The modulation adjustment is done by Pot **RV601**, and directed to a four-pole active low-pass filter. The resulting signal is then limited, and is directed to a low pass filter (18dB per octave roll-off above 3KHz). The audio is then directed through the 25KHz/12.5KHz channel spacing SW **Q601** to varactor diode **Q329** in transmit VCO. By varying the voltage on the varactor diode **Q329** at an audio rate, VCO output is frequency-modulated.

3.6.4.2 CTCSS Tone Encoder / Digital Code Squelch (DCS) Encoder

CTCSS signals and DCS signals are synthesized by CPU **Q101** and appear as pulse waveform on I/O line Pin 7. This I/O line is connected to a digital-to-analog converter network (consisting of **C136**, **C173**, **R150**, **R177** and **R182**), which produces a pseudo-sine wave at its output. The waveform is smoothed by low pass filters **Q610B** to produce an acceptable sine wave output. The CTCSS tone signal is adjusted to the proper level by **RV602**.

3.7 Receiver Section

3.7.1 Receiver Front End

In the receive mode, the RF signal enters thorough the antenna, then through the low-pass filter **C439**-**C445**, and **L414**-**L416**. The diodes **Q409** and **Q410** are biased off, so that the output of the low-pass filter is coupled (**C437**, **C438**, **L413** and **R418**) to the first band-pass filter **C401**-**C406**, **C408**-**C410**, **L401**, **L402**, **PCB_L1**, **Q401**, **R401**, and to the Front End RF overload protection diode pair **Q403**. The signal from the band-pass filter is directed to the input of the RF amplifier **Q404**. The output of the RF amplifier is sent to three stages of band-pass filters, consisting of **C415**-**C429**,

C486, **L404**-**L406**, **Q405** and **R410**. The output from the band-pass filter is directed to the mixer's **Q407**/**L407**.

3.7.2 Local Oscillator (LO)

The Receive VCO (**C344**-**C351**, **L302**, **L305**, **L306**, **L312**-**L314**, **Q311**, and **Q324**) provides the LO signal. The VCO is running at 45.1 MHz above the desired receive frequency and is applied to output Buffer **Q308**/**Q416**. The output of the buffer is sent through the low-pass filter **C430**, **C431**, **L409**, and to the mixer **Q407**/**L408**.

3.7.3 Mixer

The mixer is a DBM type (**L407**, **Q407**, **L408**). The mixer LO frequency is 45.1 MHz above the desired receiver frequency. When the receiver frequency is present, the mixer output will be a 45.1MHz signal. The mixer output is peaked for 45.1MHz at **L410**, **C432** and **R413**, and the signal is filtered by crystal filter **F402** and amplified by **Q408** before being sent to IF IC **Q506**. The 45.1MHz IF signal and LO frequency of 44.645 MHz (**X501**) are mixed in **Q506**. The 455kHz ceramic filter, **F501** or **F502**, filters the second mixer's output. The resulting signal is the second IF signal. The mixer's output is then fed to the internal limiting amplifier, and consequently to the FM decoder.

3.7.4 FM Detector and Squelch

The FM detector output is used for squelch, decoding tones and audio output. The squelch amplifier is inside of **Q506**, and its output is fed to an internal rectifier and squelch detector. The output on Q506 Pin 14 signals the CPU Q101 with a low (~0V) to unmute the radio. The audio is unmuted by the CPU Q101 Pin 41 switching to a high (5V), thus biasing on Q503. The audio is then routed to the audio amplifier **Q702** via the volume control **SW201**.

3.7.5 Receiver Audio Circuit

The detector's audio output also is fed to the tone (CTCSS and DCS) low-pass filter **Q505A**. Then the output of the low-pass filter is routed to the second stage filter **Q505B**. The output of **Q505B** is passed to **Q505C**. The output of **Q505C** is directed to the squaring circuit **Q505D**, and finally to the CPU **Q101** Pin22 for decoding.

The detector output feeds the audio high-pass filter **Q502**. The output of the audio high-pass filter feeds the Volume Control **SW201** (VOL). From the wiper arm on the Volume Control, the audio is routed to Pin 4, which is the input to the audio power amplifier **Q702**. The output of the audio power amplifier is routed through the earphone jack **J701** to the internal speaker **SP701**.

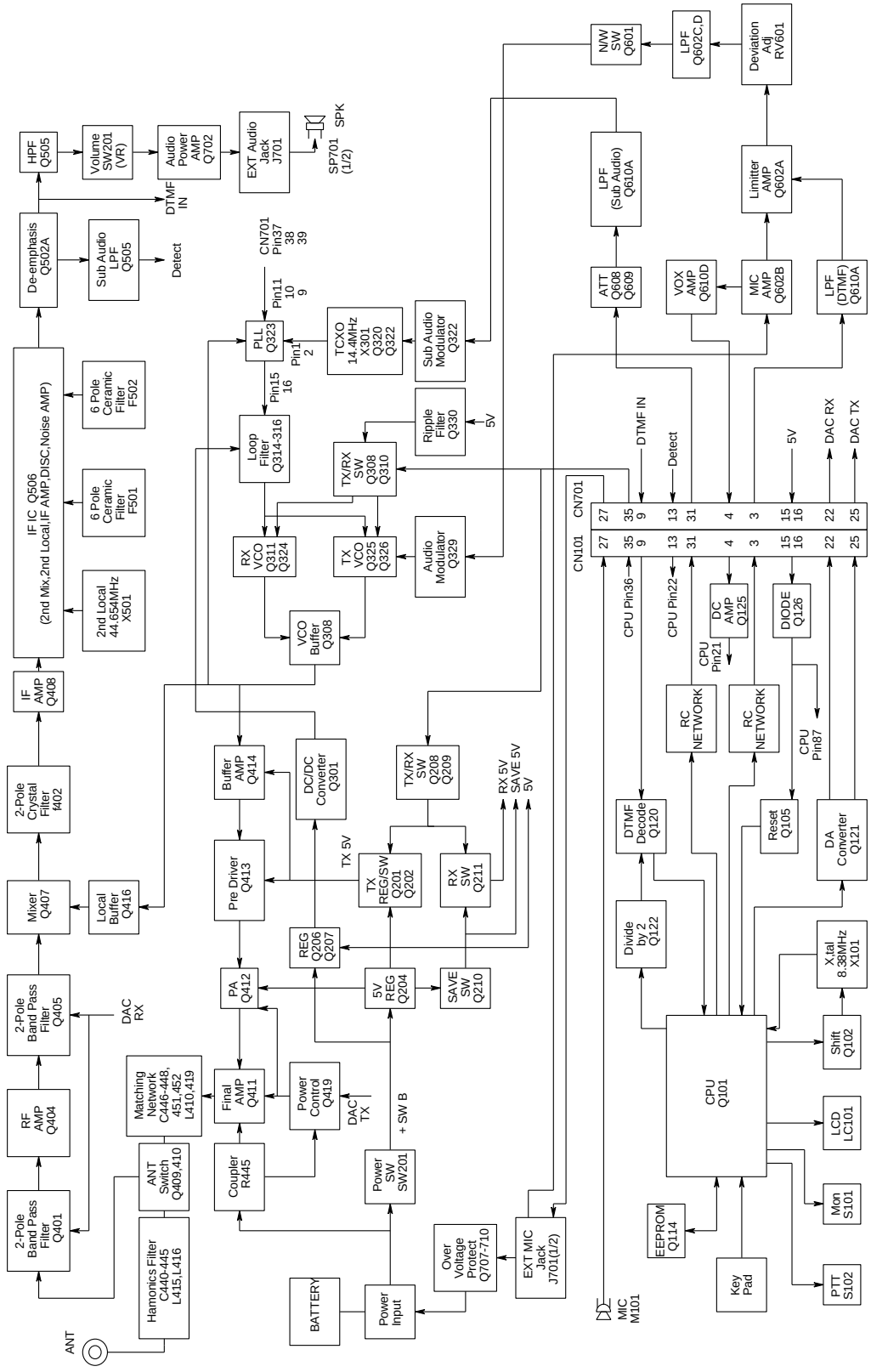
3.8 Battery Section

The battery connects to the contact (**CN201**). The positive terminal of the battery connects to the ON/OFF Volume control switch (**SW201**), and the negative terminal connects to PWB ground. Low battery is detected by **R127**/**R128** and voltage regulator **Q204**.

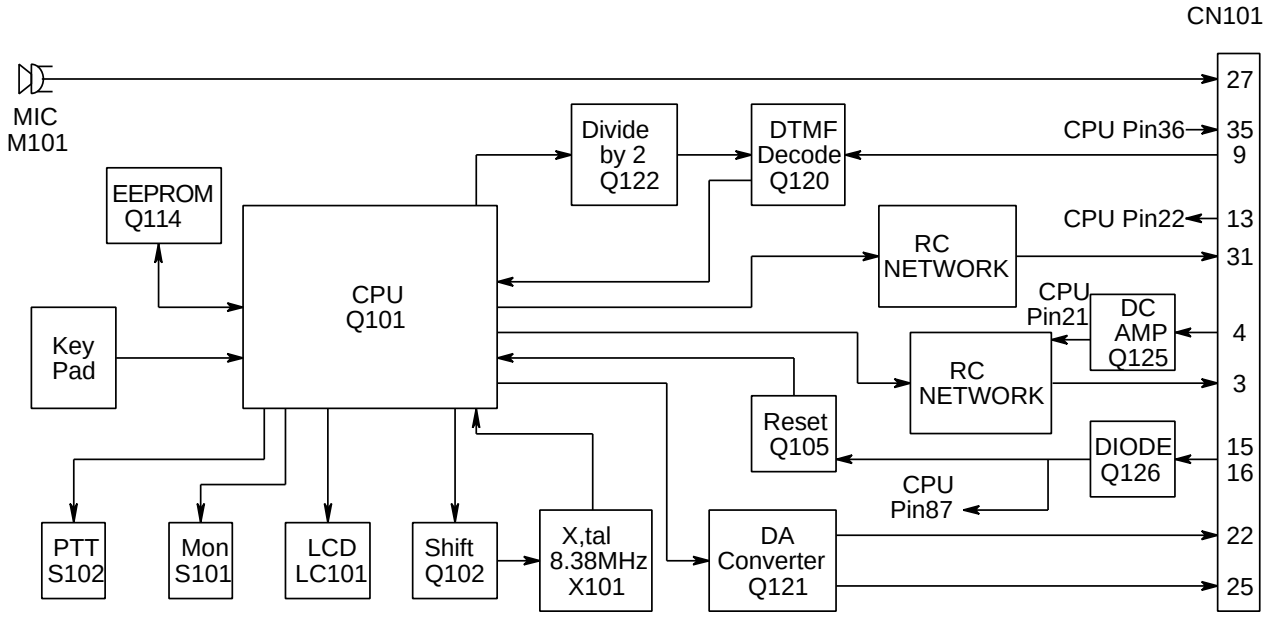
Battery voltage status is monitored by Pin 19 of the CPU **Q101** through **R127**/**R128**. When the battery voltage goes below the threshold voltage, "LOW BATT" is displayed on LCD **LC101**. In the BATTERY SAVER Mode, the CPU **Q101** generates a square wave signal on Pin 37. The signal's duty cycle varies according to what the BATTERY SAVE TIMER is set. When the signal goes high (approximately 5 V), **Q210** is biased off, and **Q211** is cut off, thus turning the supply off to IF IC **Q506**.

4.0 Block Diagrams

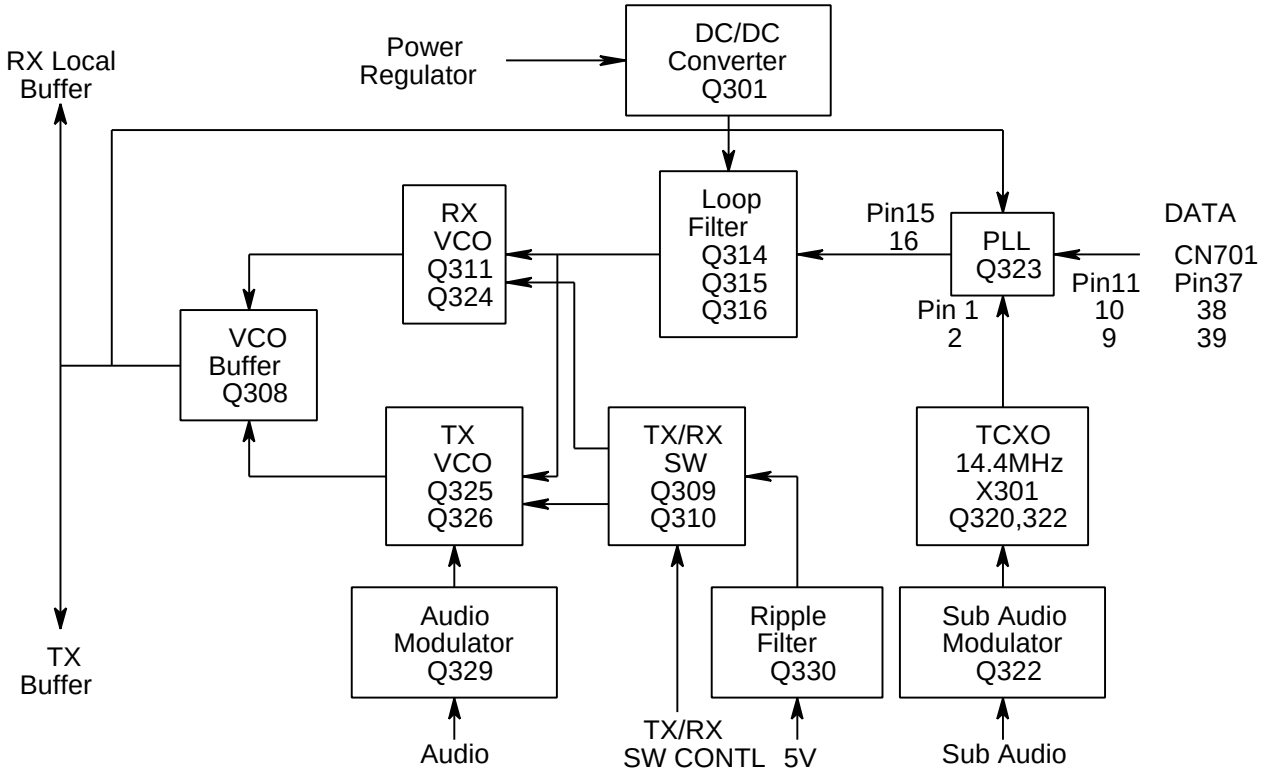
4.1 Complete



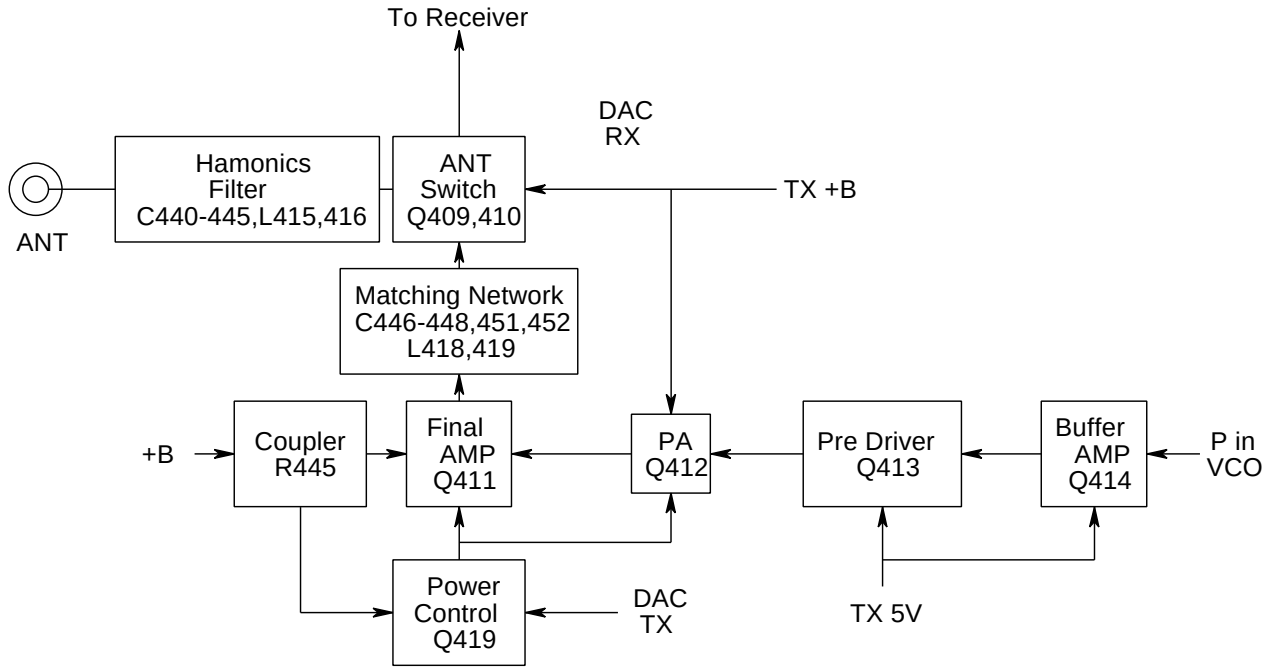
4.2 Controller



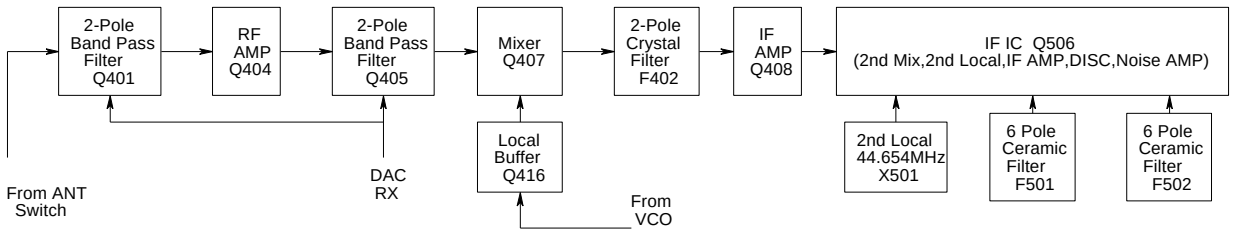
4.3 VCO



4.4 Transmitter

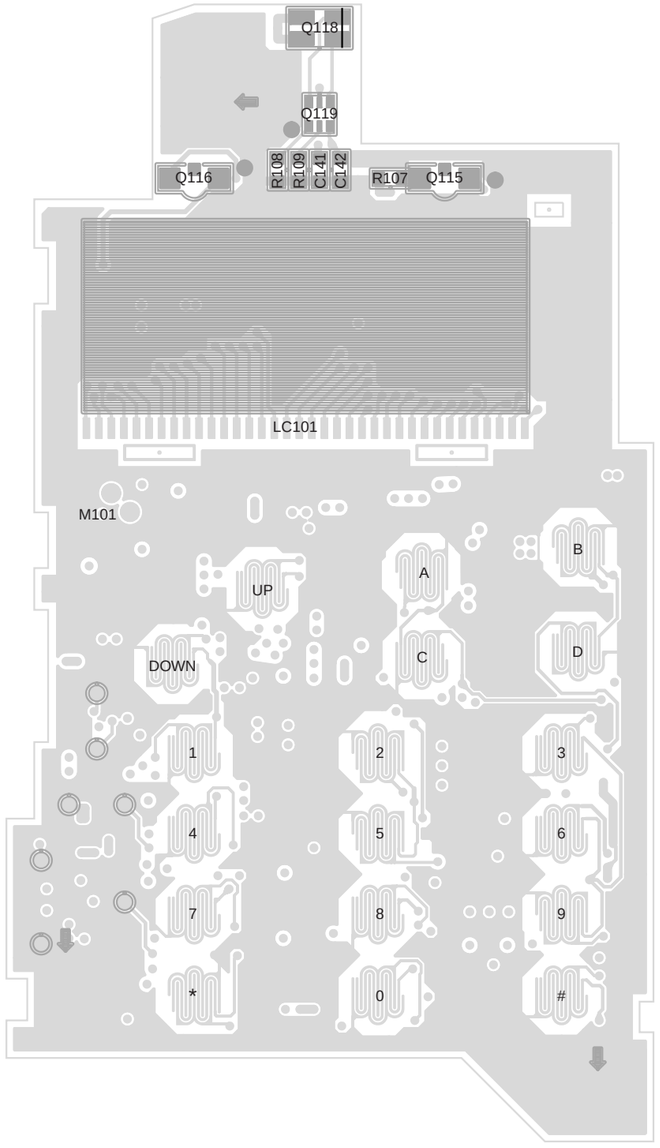


4.5 Receiver

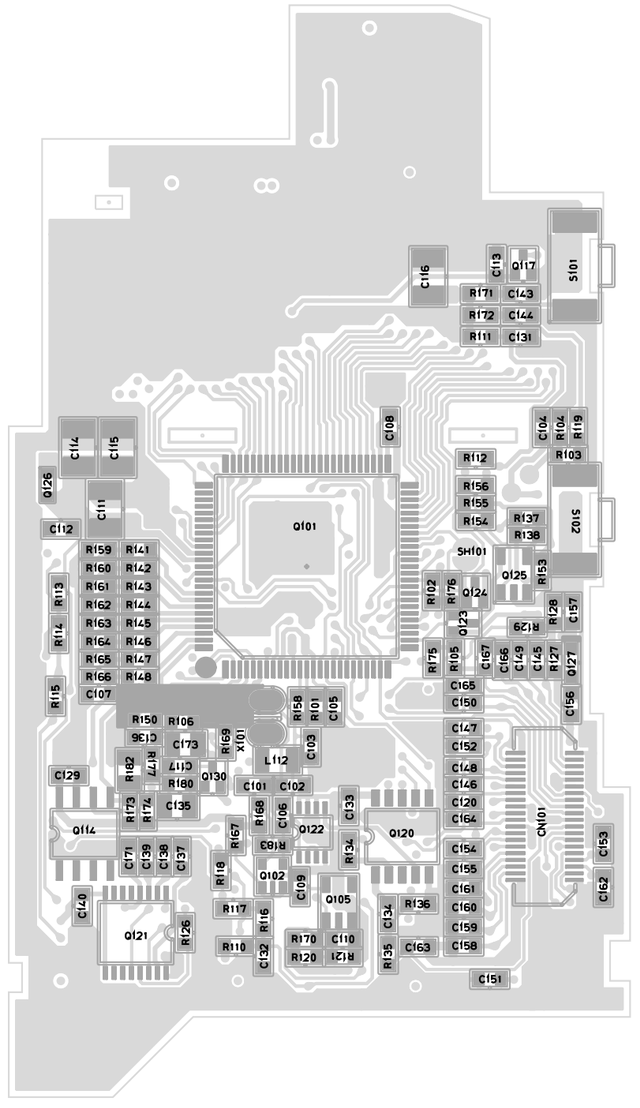


This page is intentionally left blank.

5.0 Circuit Board/Schematic Diagrams and Parts List

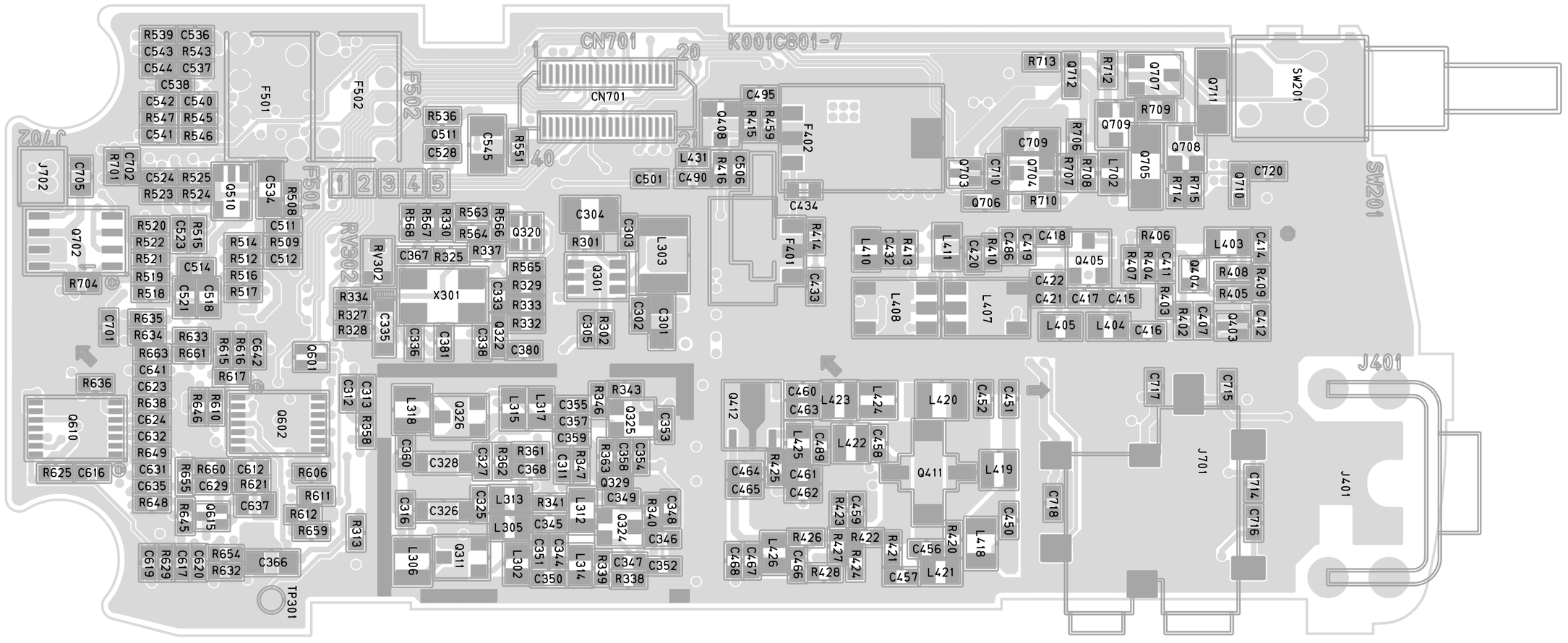


Top Side

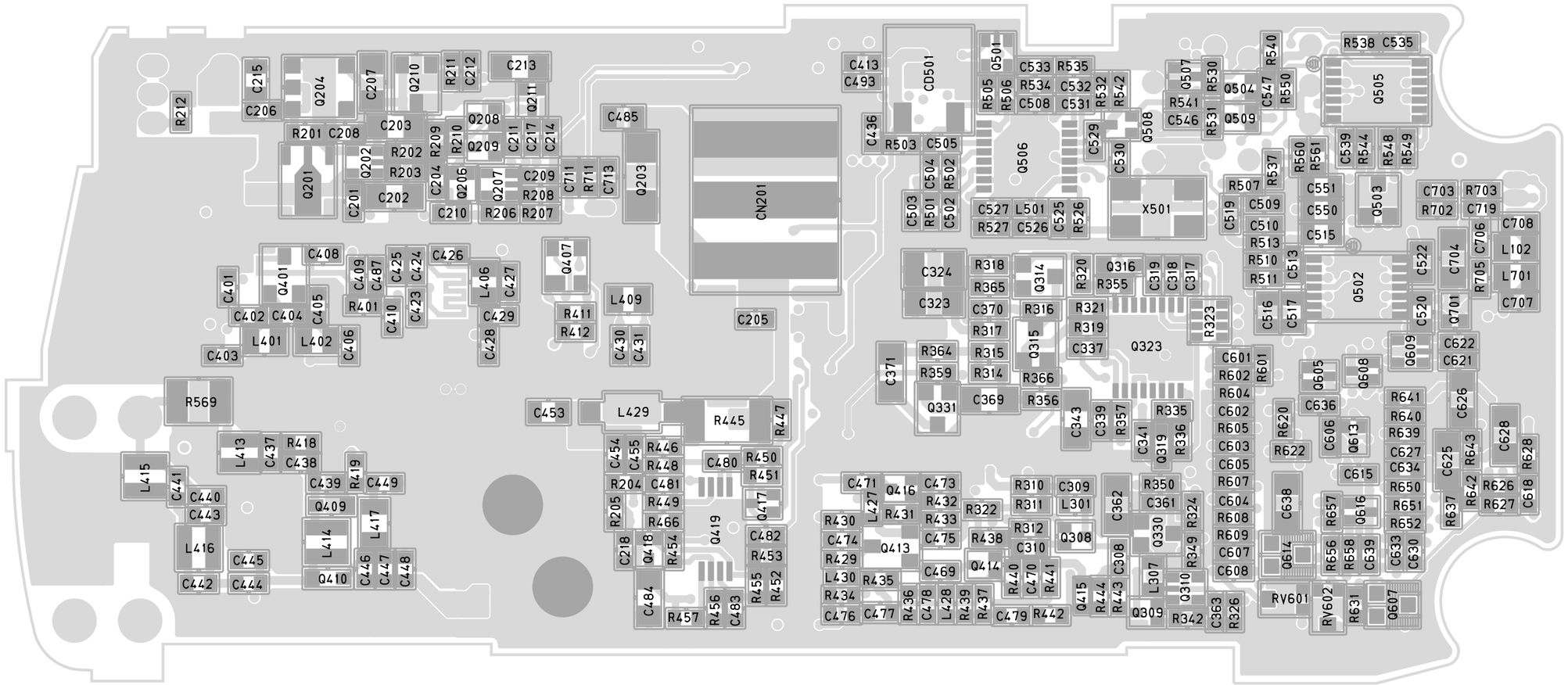


Bottom Side

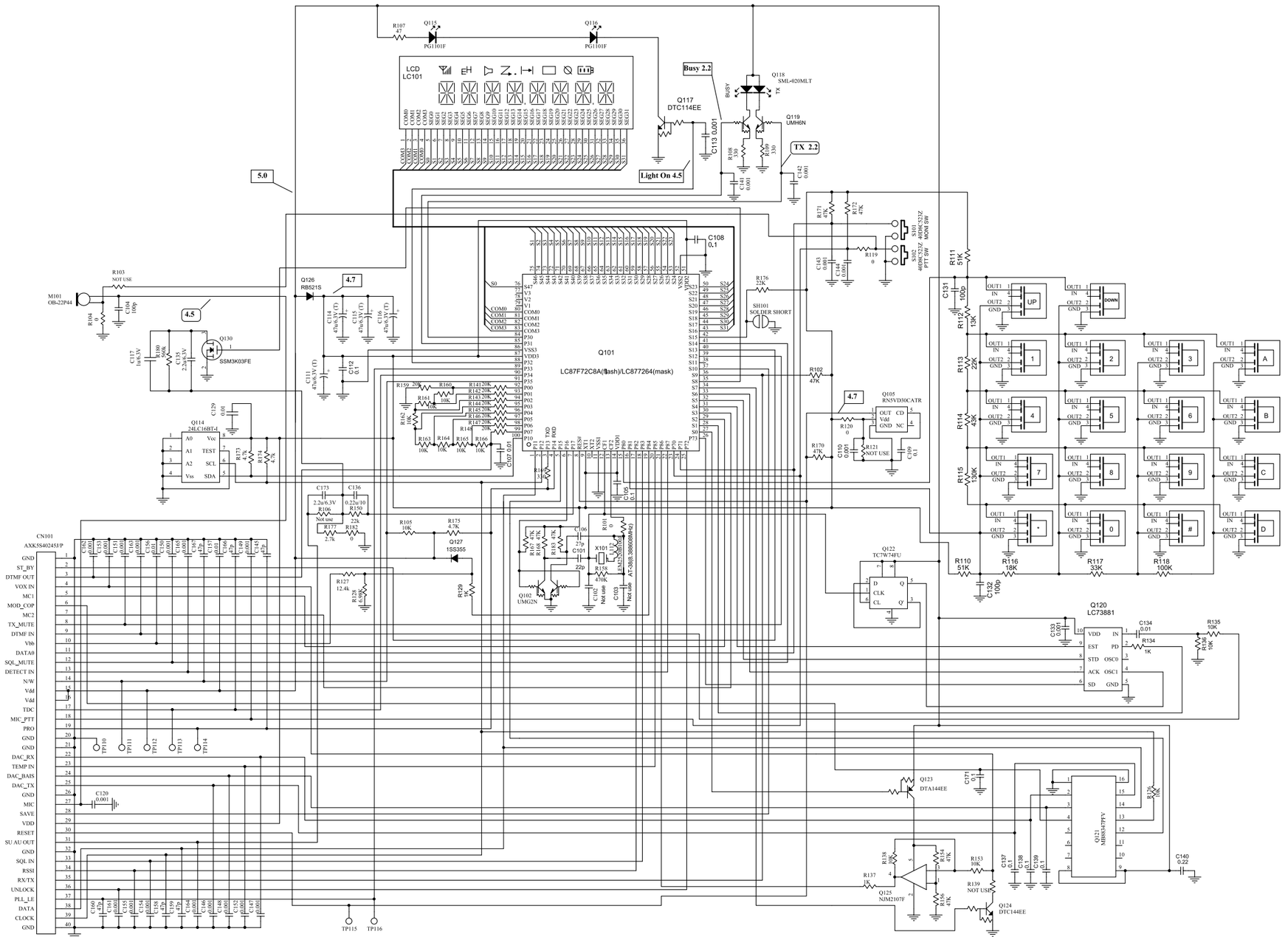
Controller Board



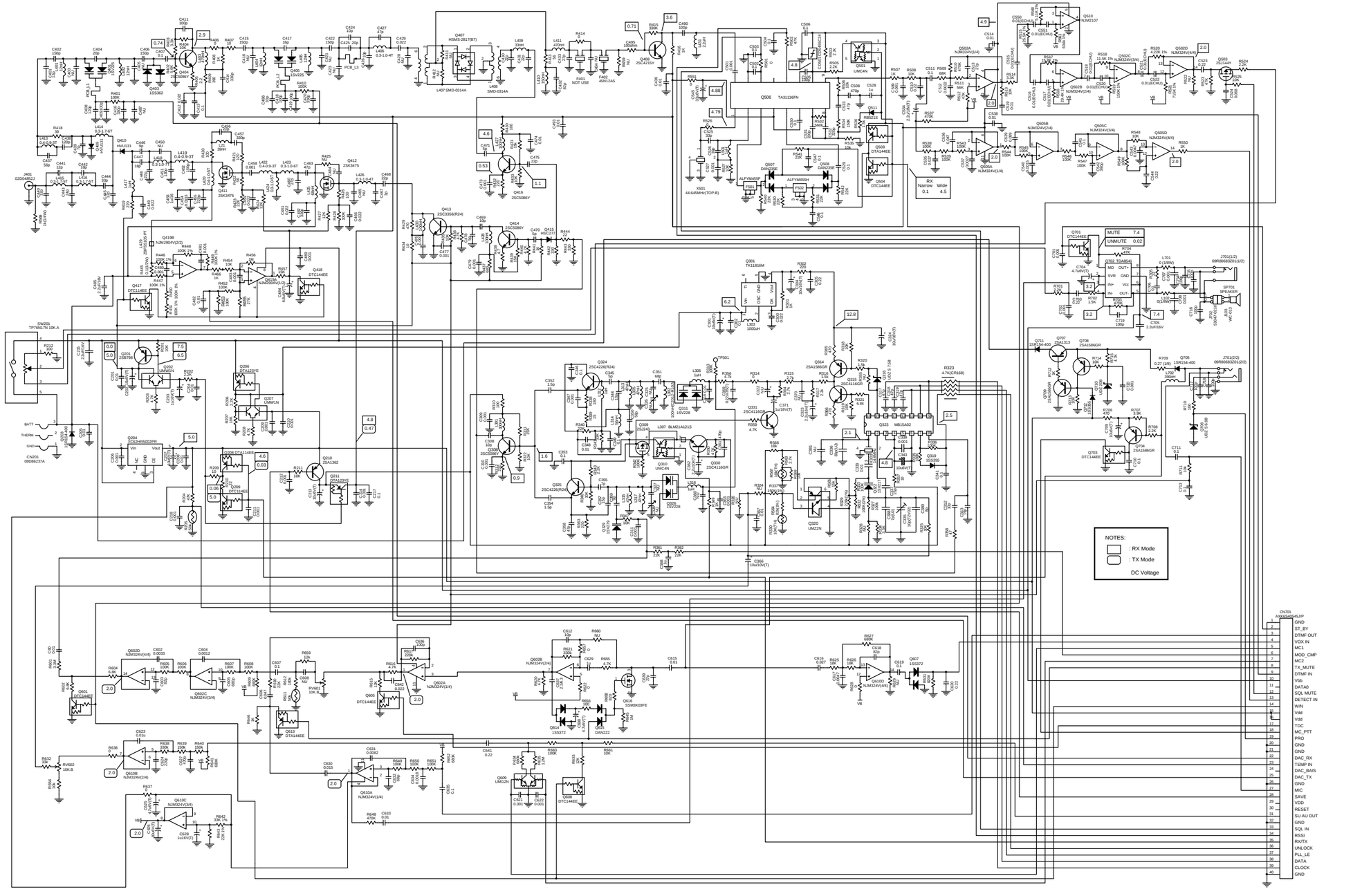
VHF 136-174 MHz Main Board Top Side



VHF 136-174 MHz Main Board Bottom Side



Complete Controller Board Schematic Diagram



VHF 136-174 MHz RF Board Schematic Diagram

VHF 136-174 MHz Radio Parts List (Controller Board)

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
	CAPACITOR			
C101	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C102	10pF; 50V; +-0.5pF	Murata	GRM39CH100D50PT	2113740F27
C103	10pF; 50V; +-0.5pF	Murata	GRM39CH100D50PT	2113740F27
C104	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C105	0.1uF; 25V; +-10%	Murata	GRM39B104K25PT	N/A
C106	33pF; 50V; +-5%	Murata	GRM39CH330J50PT	2113740F39
C107	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C108	0.1uF; 25V; +-10%	Murata	GRM39B104K25PT	N/A
C109	0.1uF; 25V; +-10%	Murata	GRM39B104K25PT	N/A
C110	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C111	47uF; 6.3V; +-20%	Ni-Chemi-Con	6MCM476MB2TER	N/A
C112	0.1uF; 25V; +-10%	Murata	GRM39B104K25PT	N/A
C113	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C114	47uF; 6.3V; +-20%	Ni-Chemi-Con	6MCM476MB2TER	N/A
C115	47uF; 6.3V; +-20%	Ni-Chemi-Con	6MCM476MB2TER	N/A
C116	47uF; 6.3V; +-20%	Ni-Chemi-Con	6MCM476MB2TER	N/A
C117	1uF; 6.3V; +-10%	Murata	GRM39B105K6.3PT	2113928P04
C120	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C129	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C131	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C132	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C133	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C134	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C135	2.2uF; 6.3V; +-10%	Murata	GRM40B225K6.3PT	N/A
C136	0.22uF; 10V; +-10%	Murata	GRM39B224K10PT	2113928G01
C137	0.1uF; 25V; +-10%	Murata	GRM39B104K25PT	N/A
C138	0.1uF; 25V; +-10%	Murata	GRM39B104K25PT	N/A
C139	0.1uF; 25V; +-10%	Murata	GRM39B104K25PT	N/A
C140	0.22uF; 10V; +-10%	Murata	GRM39B224K10PT	2113928G01
C141	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C142	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C143	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C144	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C145	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C146	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C147	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C148	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C149	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C150	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C151	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C152	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C153	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C154	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C155	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C156	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C157	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C158	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C159	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C160	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C161	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C162	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C163	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C164	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C165	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C166	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C167	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C171	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C173	2.2uF; 6.3V; +-10%	Murata	GRM40B225K6.3PT	N/A
	TRANSISTOR:			
Q102	Dual NPN	Rohm	UMG2N TR	N/A
Q117	NPN	Rohm	DTC114EETL	N/A
Q119	Dual NPN	Rohm	UMH6N TR	4880439V02
Q123	PNP	Rohm	DTA144EETL	N/A
Q124	NPN	Rohm	DTC144EETL	4880048M03
Q130	FET	Toshiba	SSM3K03FE-TE85L	N/A
	DIODE:			
Q126	Single	Rohm	RB521S-30 TE61	4805656W22
Q127	Single	Rohm	1SS355 TE-17	4870360C15
	INTEGRATED CIRCUIT:			
Q105	“IC, CPU Reset “	Rico	RN5VD30CATR	N/A
Q114	“IC, EEPROM”	Seiko El.	S-24C16AFJ-01	DSIC510003
Q120	“IC, DTMF Decoder”	Sanyo	LC73881M	DSIC092007
Q121	“IC, D/A Converter”	Fujitsu	MB88347PFV	DSIC042002
Q122	“IC, D Flip-flop”	Toshiba	TC7W74FU TE12L	DSIC013029
Q125	“IC, Op-Amp”	JRC	NJM2107F (TE1)	DSIC025016
	LIGHT EMITTING DIODE:			
Q115	Green	Stanley	PG1101F-TR	N/A
Q116	Green	Stanley	PG1101F-TR	N/A
Q118	Green/Red/Amber	Rohm	SML-020MLT T86NN	4804810T02
	COIL:			
L112	10uH	Taiyo Uden	LEM2520T100J	N/A
	JACK:			
CN101	Connector	Matsushita	AXK5S40245J/P	DSCN097002
S101	Tact Switch	Motorola	Y39A33110FP	4080523Z01
S102	Tact Switch	Motorola	Y39A33110FP	4080523Z01
	MODULE:			
Q101	CPU	Sanyo	LC87F72C8A	DSIC092009
LC101	LCD	Picvue	HT138ZAS	DSLC170003
M101	Capacitor Microphone	Bosung	OB-22P44	DSMI505001
	CRYSTAL:			
X101	“Filter, 8.388608 MHz”	Daishinkuu	AT-38	DSXT182001
	RESISTOR:			
R101	470 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 470	0662057A41
R102	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R104	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R105	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R107	470 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 470	0662057A17
R108	330 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 331	0662057A37
R109	330 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 331	0662057A37

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
R110	51 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 513	0662057A90
R111	51 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 513	0662057A90
R112	13 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 133	0662057A76
R113	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R114	43 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 433	0665027A88
R115	130 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 134	0662257B01
R116	18 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 183	0662057A79
R117	33 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 333	0662057A85
R118	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R119	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R120	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R126	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R127	12.4 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 1242	0662057P69
R128	6.98 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 6981	0662057Y24
R129	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R134	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R135	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R136	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R137	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R138	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R141	20 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 203	0662057A80
R142	20 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 203	0662057A80
R143	20 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 203	0662057A80
R144	20 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 203	0662057A80
R145	20 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 203	0662057A80
R146	20 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 203	0662057A80
R147	20 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 203	0662057A80
R148	20 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 203	0662057A80
R150	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R153	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R154	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R156	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R158	470 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 474	0662057B14
R159	20 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 203	0662057A80
R160	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R161	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R162	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R163	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R164	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R165	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R166	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R167	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R168	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R169	330 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 331	0662057A37
R170	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R171	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R172	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R173	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R174	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R175	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R176	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R177	2.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 272	0662057A59
R180	560 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 564	0662057B16
R182	0 ohm; 0.1W; +-5%	Rohm	MCR10 EZH J 000	0662057C01
R183	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89

VHF 136-174 MHz Radio Parts List (RF Board)

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
	CAPACITOR			
C201	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C202	10uF; 6.3V; +-20%	NEC	TEMSVA0J106M8R	N/A
C203	1uF; 16V; +-20%	NEC	TESVA1C105M1-8R	N/A
C204	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C205	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C206	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C207	10uF; 6.3V; +-20%	NEC	TEMSVA0J106M8R	N/A
C208	0.001uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C209	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C210	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C211	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C212	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C213	10uF; 6.3V; +-20%	NEC	TEMSVA0J106M8R	N/A
C214	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C215	2.2uF; 6.3V; +-10%	Murata	GRM40F225Z16PT	2113743F18
C217	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C218	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C301	10uF; 6.3V; +-20%	NEC	TEMSVA0J106M8R	N/A
C302	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C303	0.022uF; 50V; +-10%	Murata	GRM39B223K50PT	N/A
C304	10uF; 6.3V; +-20%	NEC	16MCM106MB2TER	N/A
C305	0.22uF; 10V; +-10%	Murata	GRM39B224K10PT	2113928G01
C308	10pF; 50V; +-0.5pF	Murata	GRM39CH100D50PT	2113740F27
C309	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C310	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C311	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C312	10pF; 50V; +-0.5pF	Murata	GRM39CH100D50PT	2113740F27
C313	15pF; 50V; +-5%	Murata	GRM39CH150J50PT	2113740F31
C316	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C317	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C318	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C319	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C323	2.2uF; 16V; +-20%	NEC	TEMSVA1C225M8R	N/A
C324	10uF; 16V; +-20%	NEC	16MCM106MB2TER	N/A
C325	Not Placed	----------	----------	----------
C326	Not Placed	----------	----------	----------
C327	Not Placed	----------	----------	----------
C328	Not Placed	----------	----------	----------
C333	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C335	10pF	Murata	TZV02Z100A110T00	N/A

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
C336	33pF; 50V; +-5%	Murata	GRM39UJ330J50PT	N/A
C337	15pF; 50V; +-5%	Murata	GRM39CH150J50PT	2113740F31
C338	7pF; 50V; +-0.5pF	Murata	GRM39UJ070D50PT	N/A
C339	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C341	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C343	10uF; 6.3V; +-20%	NEC	TEMSVA0J106M8R	N/A
C344	13pF; 50V; +-5%	Murata	GRM39CH130J50PT	2113740F30
C345	5pF; 50V; +-0.25pF	Murata	GRM39CH050C50PT	N/A
C346	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C347	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C348	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C349	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C350	56pF; 50V; +-5%	Murata	GRM39CH560J50PT	2113740F45
C351	68pF; 50V; +-5%	Murata	GRM39CH680J50PT	2113740F47
C352	1.5pF; 50V; +-0.25pF	Murata	GRM39CK1R5C50PT	N/A
C353	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C354	1.5pF; 50V; +-0.25pF	Murata	GRM39CK1R5C50PT	N/A
C355	22pF; 50V; +-5pF	Murata	GRM39CH220J50PT	2113740F35
C357	15pF; 50V; +-5%	Murata	GRM39CH150J50PT	2113740F31
C358	33pF; 50V; +-5%	Murata	GRM39CH330J50PT	2113740F39
C359	9pF; 50V; +-0.5pF	Murata	GRM39CH090D50PT	N/A
C360	Not Placed	----------	----------	----------
C361	470pF; 50V; +-10%	Murata	GRM39B471K50PT	N/A
C362	2.2uF; 10V; +-20%	NEC	TESVA1A225M1-8R	N/A
C363	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C366	10uF; 10V; +-20%	NEC	TESVA1A106M8R	N/A
C367	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C368	1uF; 6.3V; +-10%	Murata	GRM39B105K6.3PT	2113928P04
C369	0.22uF; 35V; +-20%	NEC	TESVA1V224M8R	N/A
C370	Not Placed	----------	----------	----------
C371	1uF; 16V; +-20%	NEC	TESVA1C105M1-8R	N/A
C380	8pF; 50V; +-0.5pF	Murata	GRM39CH080D50PT	N/A
C381	Not Placed	----------	----------	----------
C401	13pF; 50V; +-5%	Murata	GRM39CH130J50PT	2113740F30
C402	150pF; 50V; +-5%	Murata	GRM39CH151J50PT	2113740F55
C403	Not Placed	----------	----------	----------
C404	20pF; 50V; +-5%	Murata	GRM39CH200J50PT	2113740F34
C405	Not Placed	----------	----------	----------
C406	150pF; 50V; +-5%	Murata	GRM39CH151J50PT	2113740F55
C407	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C408	120pF; 50V; +-5%	Murata	GRM39CH121J50PT	2113740F53
C409	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C410	330pF; 50V; +-10%	Murata	GRM39B331K50PT	N/A
C411	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C412	0.022uF; 50V; +-10%	Murata	GRM39B223K50PT	N/A
C413	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C414	330pF; 50V; +-10%	Murata	GRM39B331K50PT	N/A
C415	150pF; 50V; +-5%	Murata	GRM39CH151J50PT	2113740F55
C416	Not Placed	----------	----------	----------
C417	16pF; 50V; +-5%	Murata	GRM39CH160J50PT	2113740F32
C418	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C419	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C420	330pF; 50V; +-10%	Murata	GRM39B331K50PT	N/A
C421	Not Placed	----------	----------	----------
C422	150p; 50V; +-0.5pF	Murata	GRM39CH100D50PT	2113740F27
C423	Not Placed	----------	----------	----------
C424	10pF; 50V; +-0.5pF	Murata	GRM39CH100D50PT	2113740F27
C425	20pF; 50V; +-5%	Murata	GRM39CH200J50PT	2113740F34
C426	10pF; 50V; +-0.5pF	Murata	GRM39CH100D50PT	2113740F27
C427	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C428	Not Placed	----------	----------	----------
C429	0.022uF; 50V; +-10%	Murata	GRM39B223K50PT	N/A
C430	22pF; 50V; +-5%	Murata	GRM39CH220J50PT	2113740F35
C431	22pF; 50V; +-5%	Murata	GRM39CH220J50PT	2113740F35
C432	82pF; 50V; +-5%	Murata	GRM39CH820J50PT	2113740F49
C433	27pF; 50V; +-5%	Murata	GRM39CH270J50PT	2113740F37
C434	Not Placed	----------	----------	----------
C436	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C437	56pF; 50V; +-10%	Murata	GRM39CH560J50PT	2113740F45
C438	120pF; 50V; +-5%	Murata	GRM39CH121J50PT	2113740F53
C439	7pF; 50V; +-0.5pF	Murata	GRM39CH070D50PT	N/A
C440	12pF; 50V; +-5%	Murata	GRM39CH120J50PT	2113740F29
C441	12pF; 50V; +-5%	Murata	GRM39CH120J50PT	2113740F29
C442	10pF; 50V; +-5%	Murata	GRM39CH100J50PT	N/A
C443	24pF; 50V; +-5%	Murata	GRM39CH240J50PT	2113740F36
C444	33pF; 50V; +-5%	Murata	GRM39CH330J50PT	2113740F39
C445	12pF; 50V; +-5%	Murata	GRM39CH120J50PT	2113740F29
C446	9pF; 50V; +-0.5pF	Murata	GRM39CH090D50PT	N/A
C447	18pF; 50V; +-5%	Murata	GRM39CH180J50PT	2113740F33
C448	22pF; 50V; +-5%	Murata	GRM39CH220J50PT	2113740F35
C449	0.022uF; 50V; +-10%	Murata	GRM39B223K50PT	N/A
C450	Not Placed	----------	----------	----------
C451	120pF; 50V; +-5%	Murata	GRM39CH121J50PT	2113740F53
C452	150pF; 50V; +-5%	Murata	GRM39CH151J50PT	2113740F55
C453	1uF; 16V; +-10%	Murata	GRM40B105K16PT	2113743A31
C454	0.0033uF; 50V; +-10%	Murata	GRM39B332K50PT	2155169M15
C455	220pF; 50V; +-10%	Murata	GRM39B221K50PT	N/A
C456	22pF; 50V; +-5%	Murata	GRM39CH220J50PT	2113740F35
C457	330pF; 50V; +-10%	Murata	GRM39B331K50PT	N/A
C458	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C459	0.022uF; 50V; +-10%	Murata	GRM39B223K50PT	N/A
C460	27pF; 50V; +-5%	Murata	GRM39CH270J50PT	2113740F37
C461	0.022uF; 50V; +-10%	Murata	GRM39B223K50PT	N/A
C462	330pF; 50V; +-10%	Murata	GRM39B331K50PT	N/A
C463	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C464	Not Placed	----------	----------	----------
C465	Not Placed	----------	----------	----------
C466	0.022uF; 50V; +-10%	Murata	GRM39B223K50PT	N/A
C467	3pF; 50V; +-0.25pF	Murata	GRM39CJ030C50PT	2103689A09
C468	22pF; 50V; +-5%	Murata	GRM39CH220J50PT	2113740F35
C469	10pF; 50V; +-0.5pF	Murata	GRM39CH100D50PT	2113740F27
C470	5pF; 50V; +-0.25pF	Murata	GRM39CH050C50PT	N/A

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
C471	5pF; 50V; +-0.25pF	Murata	GRM39CH050C50PT	N/A
C473	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C474	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C475	22pF; 50V; +-5%	Murata	GRM39CH220J50PT	2113740F35
C476	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C477	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C478	5pF; 50V; +-0.25pF	Murata	GRM39CH050C50PT	N/A
C479	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C480	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C481	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C482	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C483	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C484	6.8uF; 6.3V; +-20%	NEC	TEMSVA0J685M8R	N/A
C485	2.2uF; 16V; +-0%	Murata	GRM40F225Z16PT	2113743F18
C486	33pF; 50V; +-5%	Murata	GRM39CH330J50PT	2113740F39
C487	Not Placed	----------	----------	----------
C489	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C490	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C493	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C495	18pF; 50V; +-5%	Murata	GRM39CH180J50PT	2113740F33
C501	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C502	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C503	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C504	0.1uF; 25V; +-10%	Murata	GRM39B104K25PT	N/A
C505	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C506	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C508	470pF; 50V; +-10%	Murata	GRM39B471K50PT	N/A
C509	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C510	0.22uF; 10V; +-10%	Murata	GRM39B224K10PT	2113928G01
C511	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C512	0.0022uF; 50V; +-10%	Murata	GRM39B222K50PT	N/A
C513	27pF; 50V; +-5%	Murata	GRM39CH270J50PT	2113740F37
C514	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C515	0.01uF; 16V; +-2%	Panasonic	ECHU1C103GX5	DSCF097003
C516	0.01uF; 16V; +-2%	Panasonic	ECHU1C103GX5	DSCF097003
C517	0.01uF; 16V; +-2%	Panasonic	ECHU1C103GX5	DSCF097003
C518	0.01uF; 16V; +-2%	Panasonic	ECHU1C103GX5	DSCF097003
C519	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C520	0.01uF; 16V; +-2%	Panasonic	ECHU1C103GX5	DSCF097003
C521	0.01uF; 16V; +-2%	Panasonic	ECHU1C103GX5	DSCF097003
C522	0.01uF; 16V; +-2%	Panasonic	ECHU1C103GX5	DSCF097003
C523	0.22uF; 50V; +-10%	Murata	GRM39B224K10PT	2113928G01
C524	0.068uF; 16V; +-10%	Murata	GRM39B683K16PT	N/A
C525	33pF; 50V; +-5%	Murata	GRM39CH330J50PT	2113740F39
C526	39pF; 50V; +-5%	Murata	GRM39CH390J50PT	2113740F41
C527	0.01uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C528	1uF; 6.3V; +-10%	Murata	GRM39B105K6.3PT	2113928P04
C529	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C530	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C531	220pF; 50V; +-10%	Murata	GRM39B221K50PT	N/A
C532	220pF; 50V; +-10%	Murata	GRM39B221K50PT	N/A

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
C533	47pF; 50V; +-5%	Murata	GRM39CH470J50PT	2113740F43
C534	2.2uF; 10V; +-20%	NEC	TESVA1A225M1-8R	N/A
C535	0.027uF; 25v; +-10%	Murata	GRM39B273K25PT	2155169N29
C536	0.047uF; 16V; +-10%	Murata	GRM39B473K16PT	N/A
C537	0.0027uF; 50V; +-10%	Murata	GRM39B272K50PT	21SW973A115
C538	0.01uF; 16V; +-2%	Murata	GRM39B103K50PT	N/A
C539	0.039uF; 16v; +-10%	Murata	GRM39B393K16PT	N/A
C540	0.0015uF; 50V; +-10%	Murata	GRM39B152K50PT	2155169M11
C541	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C542	390pF; 50V; +-10%	Murata	GRM39B391K50PT	2113741F15
C543	0.0047uF; 50V; +-10%	Murata	GRM39B472K50PT	N/A
C544	0.22uF; 10V; +-10%	Murata	GRM39B224K10PT	2113928G01
C545	33uF; 6.3V; +-20%	NEC	TEMSVB20J336M8R	N/A
C546	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C547	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C550	0.22uF; 10V; +-10%	Murata	GRM39B224K10PT	2113928G01
C551	0.01uF; 16V; +-2%	Panasonic	ECHU1C103GX5	DSCF097003
C601	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C602	0.0033uF; 50V; +-10%	Murata	GRM39B332K50PT	2155169M15
C603	82pF; 50V; +-5%	Murata	GRM39CH820J50PT	2113740F49
C604	0.0012uF; 50V; +-10%	Murata	GRM39B122K50PT	N/A
C605	680pF; 50V; +10%	Murata	GRM39B681K50PT	N/A
C606	0.047uF; 16V; +-10%	Murata	GRM39B473K16PT	N/A
C607	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C608	Not Placed	----------	----------	----------
C612	10pF; 50V; +-0.5pF	Murata	GRM39CH100D50PT	2113740F27
C615	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C616	0.027uF; 25V; +-10%	Murata	GRM39B273K25PT	2155169N29
C617	0.047uF; 25V; +-10%	Murata	GRM39B472K50PT	N/A
C618	82pF; 50V; +-5%	Murata	GRM39CH820J50PT	2113740F49
C619	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C620	0.22uF; 10V; +-10%	Murata	GRM39B224K10PT	2113928G01
C621	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C622	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C623	0.01uF; 16V; +-2%	Murata	GRM39B103K50PT	N/A
C624	220pF; 50V; +-10%	Murata	GRM39B221K50PT	N/A
C625	4.7uF; 6.3V; +-20%	NEC	TEMSVA0J475M8R	N/A
C626	10uF; 6.3V; +-20%	NEC	TEMSVA0J106M8R	N/A
C627	470pF; 50V; +-10%	Murata	GRM39B471K50PT	N/A
C628	1uF; 16V; +-20%	NEC	TESVA1C105M1-8R	N/A
C629	1pF; 6.3V; +-10%	Murata	GRM39B105K6.3PT	2113928P04
C630	0.015uF; 50V; +-10%	Murata	GRM39B153K50PT	2113932E03
C631	0.082uF; 50V; +-10%	Murata	GRM39B822K50PT	N/A
C632	68pF; 50V; +-5%	Murata	GRM39CH680J50PT	2113740F47
C633	0.01uF; 50V; +-10%	Murata	GRM39B103K50PT	N/A
C634	0.0018uF; 50V; +-10%	Murata	GRM39B182K50PT	2155116E54
C635	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C636	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C637	2.2uF; 6.3V; +-20%	Murata	GRM40B225K6.3PT	N/A
C638	4.7uF; 6.3V; +-20%	NEC	TEMSVA0J475M8R	N/A
C639	27pF; 50V; +-5%	Murata	GRM39CH270J50PT	2113740F37

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
C641	1pF; 6.3V; +-10%	Murata	GRM39B105K6.3PT	2113928P04
C642	0.022uF; 50V; +-10%	Murata	GRM39B223K50PT	N/A
C701	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C702	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C703	0.22uF; 10V; +-10%	Murata	GRM39B224K10PT	2113928G01
C704	4.7uF; 6.3V; +-20%	NEC	TEMSVA0J475M8R	N/A
C705	2.2uF; 16V; +-0%	Murata	GRM40F225Z16PT	2113743F18
C706	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C707	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C708	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
C709	10uF; 6.3V; +-20%	NEC	TEMSVA0J106M8R	N/A
C710	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C711	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C713	0.1uF; 16V; +-10%	Murata	GRM39B104K16PT	N/A
C714	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C715	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C716	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C717	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C718	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C719	100pF; 50V; +-5%	Murata	GRM39CH101J50PT	2113740F51
C720	0.001uF; 50V; +-10%	Murata	GRM39B102K50PT	N/A
	TRANSISTOR:			
Q201	PNP	NEC	2SB798-T1 DK	N/A
Q202	DUAL NPN	Rohm	UMW1N TL	N/A
Q206	PNP	Rohm	DTA123YETL	N/A
Q207	DUAL NPN	Rohm	UMW1N TL	N/A
Q208	PNP	Rohm	DTA114EETL	4808317Y01
Q209	NPN	Rohm	DTC114EETL	N/A
Q210	PNP	Toshiba	2SA1362-GR TE85L	N/A
Q211	PNP	Rohm	DTA123YETL	N/A
Q308	NPN	Toshiba	2SC5086-Y TE85L	N/A
Q309	FET	NEC	2SJ243-T1	N/A
Q310	DUAL PNP/NPN	Rohm	UMC4N TR	N/A
Q314	PNP	Toshiba	2SA1586-GR TE85L	N/A
Q315	NPN	Toshiba	2SC4116-GR TE85L	N/A
Q320	DUAL PNP/NPN	Rohm	UMZ2N-TR	4809939C06
Q324	NPN	NEC	2SC4226-T1 R24	N/A
Q325	NPN	NEC	2SC4226-T1 R24	N/A
Q330	NPN	Toshiba	2SC4116-GR TE85L	N/A
Q331	NPN	Toshiba	2SC4116-GR TE85L	N/A
Q404	NPN	Toshiba	2SC5086-Y TE85L	N/A
Q408	NPN	Toshiba	2SC4215-Y TE85L	N/A
Q411	FET	Toshiba	2SK3476	DSTR013027
Q412	FET	Toshiba	2SK3475	DSTR013026
Q413	NPN	NEC	2SC3356-T1B R24	N/A
Q414	NPN	Toshiba	2SC5086-Y TE85L	N/A
Q416	NPN	Toshiba	2SC5086-Y TE85L	N/A
Q417	NPN	Rohm	DTC114EETL	N/A
Q418	NPN	Rohm	DTC144EETL	4880048M03
Q501	DUAL PNP/NPN	Rohm	UMC4N TR	N/A
Q503	FET	Toshiba	2SJ144Y-TE85L	N/A

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
Q504	NPN	Rohm	DTC144EETL	4880048M03
Q509	PNP	Rohm	DTA144EETL	N/A
Q601	NPN	Rohm	DTC144EETL	4880048M03
Q605	NPN	Rohm	DTC144EETL	4880048M03
Q608	NPN	Rohm	DTC144EETL	4880048M03
Q609	DUAL NPN	Rohm	UMG2N TR	N/A
Q613	PNP	Rohm	DTA144EETL	N/A
Q616	FET	Toshiba	SSM3K03FE-TE85L	N/A
Q701	NPN	Rohm	DTC144EETL	4880048M03
Q703	NPN	Rohm	DTC144EETL	4880048M03
Q704	PNP	Toshiba	2SA1586-GR TE85L	N/A
Q707	PNP	Toshiba	2SA1313-Y TE85L	N/A
Q708	PNP	Toshiba	2SA1586-GR TE85L	N/A
Q709	PNP	Toshiba	2SA1586-GR TE85L	N/A
	DIODE:			
Q203	Single	Rohm	1SR154-400 TE25	4842006M02
Q311	Dual Varactor	Toshiba	1SV228-TPH3	N/A
Q316	Zener; 7.6V	Rohm	UDZ S 7.5B TE-17	N/A
Q319	Single	Rohm	1SS355 TE-17	4870360C15
Q322	Varactor	Toshiba	1SV217-TPH3	N/A
Q326	Dual Varactor	Toshiba	1SV228-TPH3	N/A
Q329	Varactor	Toshiba	1SV279-TPH3	N/A
Q401	Dual Varactor	Toshiba	1SV225-TPH3	N/A
Q403	Dual Varactor	Toshiba	1SS362-TE85L	N/A
Q405	Dual Varactor	Toshiba	1SV225-TPH3	N/A
Q407	Diode	HP	HSMS-2817 (B7)	N/A
Q409	Single	Hitachi	HVU131TRF	N/A
Q410	Single	Hitachi	HVU131TRF	N/A
Q415	Single	Hitachi	HSC277TRF	N/A
Q507	Dual	Rohm	DAN235ETL	N/A
Q508	Dual	Rohm	DAN235ETL	N/A
Q511	Single	Rohm	RB521S-30 TE61	N/A
Q607	Dual	Toshiba	1SS372-TE85L	N/A
Q614	Dual	Rohm	1SS372-TE85L	N/A
Q615	Dual	Rohm	DAN222TL	4809606E02
Q705	Single	Rohm	1SR154-400 TE25	4842006M02
Q706	Zener; 6.9V	Rohm	UDZ S 6.8B TE-17	4842006M03
Q710	Zener; 20.39V	Rohm	UDZ S 20B TE-17	N/A
Q711	Single	Rohm	1SR154-400 TE25	4842006M02
Q712	Single	Rohm	1SS355 TE-17	4870360C15
	INTEGRATED CIRCUIT:			
Q204	“IC, Regulator”	Torex	XC62HR5002PR	DSIC510004
Q301	“IC, DC-DC Converter”	Toko	TK11816M	DSIC011011
Q323	“IC, PLL”	Fujitsu	MB15A02PFV1-ER	DSIC042003
Q419	“IC, Op-Amp”	JRC	NJM2904V(TE1)	DSIC510001
Q502	“IC, Op-Amp”	JRC	NJM324V(TE1)	DSIC510002
Q505	“IC, Op-Amp”	JRC	NJM324V(TE1)	DSIC510002
Q506	IF IC	Toshiba	TA31136FN-TP1	DSIC013007
Q510	“IC, Op-Amp”	JRC	NJM2107F (TE1)	DSIC025016
Q602	“IC, Op-Amp”	JRC	NJM324V(TE1)	DSIC510002
Q610	“IC, Op-Amp”	JRC	NJM324V(TE1)	DSIC510002

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
Q702	"IC, Audio Amplifier"	Philips	TDA8541T/N1	DSIC174004
	COIL:			
L102	0 ohm; 0.1W; +-5%	Rohm	MCR10 EZH J 000	0662057C01
L301	100nH	Toko	LL1608-FSR10J	2413926N24
L302	100nH	Murata	C2012C-R10J	N/A
L303	1000uH	TDK	NL453232T-102J	
L305	47nH	Sagami Elec	C2012C-47NG	2413923B12
L306	1uH	Sagami Elec	C2520C-1R0J	2462587N68
L307	Chip Emifil	Murata	BLM21A121SPT	2480067M02
L312	1uH	Toko	FSLM2520-1R0J	2485601J13
L313	47nH	Sagami Elec	C2012C-47NG	2413923B12
L314	56nH	Sagami Elec	C2012C-56NG	2413923B18
L315	47nH	Sagami Elec	C2012C-47NG	2413923B12
L317	47nH	Sagami Elec	C2012C-47NG	2413923B12
L318	1uH	Sagami Elec	C2520C-1R0J	2462587N68
L401	12nH	Sagami Elec.	C2012C-12NJ	2462587V23
L402	12nH	Sagami Elec.	C2012C-12NJ	2462587V23
L403	470nH	Toko	FSLM2520-R47K	2485602J33
L404	12nH	Sagami Elec	C2012C-12NJ	2462587V23
L405	12nH	Sagami Elec	C2012C-12NJ	2462587V23
L406	Airwound Coil	Uchida	E2-0.30-1.0-4TL	N/A
L407	Coil	Latest	SMD-0314A	N/A
L408	Coil	Latest	SMD-0314A	N/A
L409	33nH	Toko	LL2012-FH33NJ	2413926K17
L410	150nH	Sagami Elec	C2012C-R15J	2462587V36
L411	470nH	Toko	FSLM2520-R47K	2485602J33
L413	Airwound Coil	Uchida	E2-0.40-0.9-3TL	N/A
L414	Airwound Coil	Uchida	E2-0.30-1.7-6TL	N/A
L415	Airwound Coil	Uchida	E2-0.30-1.7-5TL	N/A
L416	Airwound Coil	Uchida	E2-0.30-1.7-5TL	N/A
L417	1uH	Toko	FSLM2520-1R0J	2485601J13
L418	Airwound Coil	Uchida	E2-0.30-1.0-7TL	N/A
L419	Airwound Coil	Uchida	E2-0.40-0.9-3TL	N/A
L420	Airwound Coil	Uchida	E2-0.40-1.0-5TL	N/A
L421	39nH	Sagami Elec	C2012C-39NJ	2462587V29
L422	Airwound Coil	Uchida	E2-0.40-0.9-3TL	N/A
L423	Airwound Coil	Uchida	E2-0.30-1.0-6TL	N/A
L424	Airwound Coil	Uchida	E2-0.30-1.0-5TL	N/A
L425	68nH	Sagami Elec	C2012C-68NJ	2462587V32
L426	Airwound Coil	Uchida	E2-0.30-1.0-4TL	N/A
L427	100nH	Toko	LL1608-FSR10J	2413926N24
L428	100nH	Toko	LL1608-FSR10J	2413926N24
L429	Chip Beads	TDK	ZBFS5105-PT	N/A
L430	100nH	Toko	LL1608-FSR10J	2413926N24
L431	2.2uH	TDK	MLF1608A2R2KT	N/A
L501	1uH	TDK	MLF1608A1R0KT	N/A
L702	390nH	Sagami Elec	C2012C-R39J	2462587V41
	JACK:			
CN201	Connector Contact	Motorola	09D86237A	N/A
CN701	Connector	Matsushita Denko	AXK6S40545J/P	DSCN097003

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
J401	Antenna Jack	Motorola	02D04852J	N/A
J701	Audio Jack	Motorola	09R80683Z01	N/A
	CERAMIC FILTER:			
F501	455Khz	Toko	ALFYM455F	
F502	455Khz	Toko	ALFYM455H	
	CRYSTAL			
F401	Not Placed	----------	----------	----------
F402	"Filter, 45.1 Mhz"	Hertz	45N12A5 (45.1MHz) UM-5J-SMD	DSXF137006
X301	"Crystal, 14.4MHz"	Nikko Denshi	TOP-B 14.4MHz	DSXT181001
X501	"Crystal, 44.645MHz"	Nikko Denshi	TOP-B 44.645MHz	DSXT181002
	MISCELLANEOUS			
J702	Housing	Molex	Housing 53047-0210	DSM5075001
SW201	Potentiometer	Tocos	TP76N17N A10Kohm 10SK	DSVR010008
RV302	----------	----------	Not Used	----------
CD501	Discriminator	Murata	CDBC455CX24-TP	DSFL506003
	RESISTOR:			
L701	0 ohm; 0.1W; +-5%	Rohm	MCR10 EZH J 000	0662057C01
R201	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R202	2.2 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 222	0662057A57
R203	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R204	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R205	Chip Thermistor	Hokuriku	NSM3503J400J	N/A
R206	2.2 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 222	0662057A57
R207	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R208	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R209	10 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 100	0662057A01
R210	22 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 220	0662057A09
R211	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R212	100 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 101	0662057A25
R301	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R302	220 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 221	0662057A33
R310	100 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 101	0662057A25
R311	15 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 153	0662057A77
R312	220 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 221	0662057A33
R313	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R314	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R315	2.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 272	0662057A59
R316	1.5 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 152	0662057A53
R317	2.2 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 222	0662057A57
R318	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R319	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R320	1.5 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 152	0662057A53
R321	6.8 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 682	0662057A69
R322	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R323	Chip Network Resistor	Hokuriku	CRA168-472J	N/A
R324	Not Placed	----------	----------	----------
R325	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R326	Not Placed	----------	----------	----------
R327	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
R328	Not Placed	----------	----------	----------
R329	220 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 2203	N/A
R330	Chip Thermistor	Murata	NTH5G16P39A103K07 TH	N/A
R332	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHF 1003	0662057P95
R333	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R334	3.3 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 332	0662057A61
R335	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R336	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R337	150 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 1503	0662057P97
R338	180 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 181	0662057A31
R339	15 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 150	0662057A05
R340	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R341	33 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 333	0662057A85
R342	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R343	2.2 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 222	0662057A57
R346	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R347	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R349	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R350	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R355	Not Placed	----------	----------	----------
R356	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R357	10 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 100	0662057A01
R358	47 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 470	0662057A17
R359	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R361	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R362	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R363	470 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 471	0662057A41
R364	2.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 272	0662057A59
R365	470 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 471	0662057A41
R366	470 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 471	0662057A41
R401	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R402	5.6 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 562	0662057A67
R403	3.3 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 332	0662057A61
R404	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R405	2.2 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 2R2	0662057W09
R406	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R407	10 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 100	0662057A01
R408	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R409	390 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 391	0662057A39
R410	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R411	Not Placed	----------	----------	----------
R412	Not Placed	----------	----------	----------
R413	56 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 560	0662057A19
R414	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R415	330 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 334	0662057B10
R416	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R418	39 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 390	0662057A15
R419	220 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 221	0662057A33
R420	100 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 101	0662057A25
R421	120 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 121	0662057A27

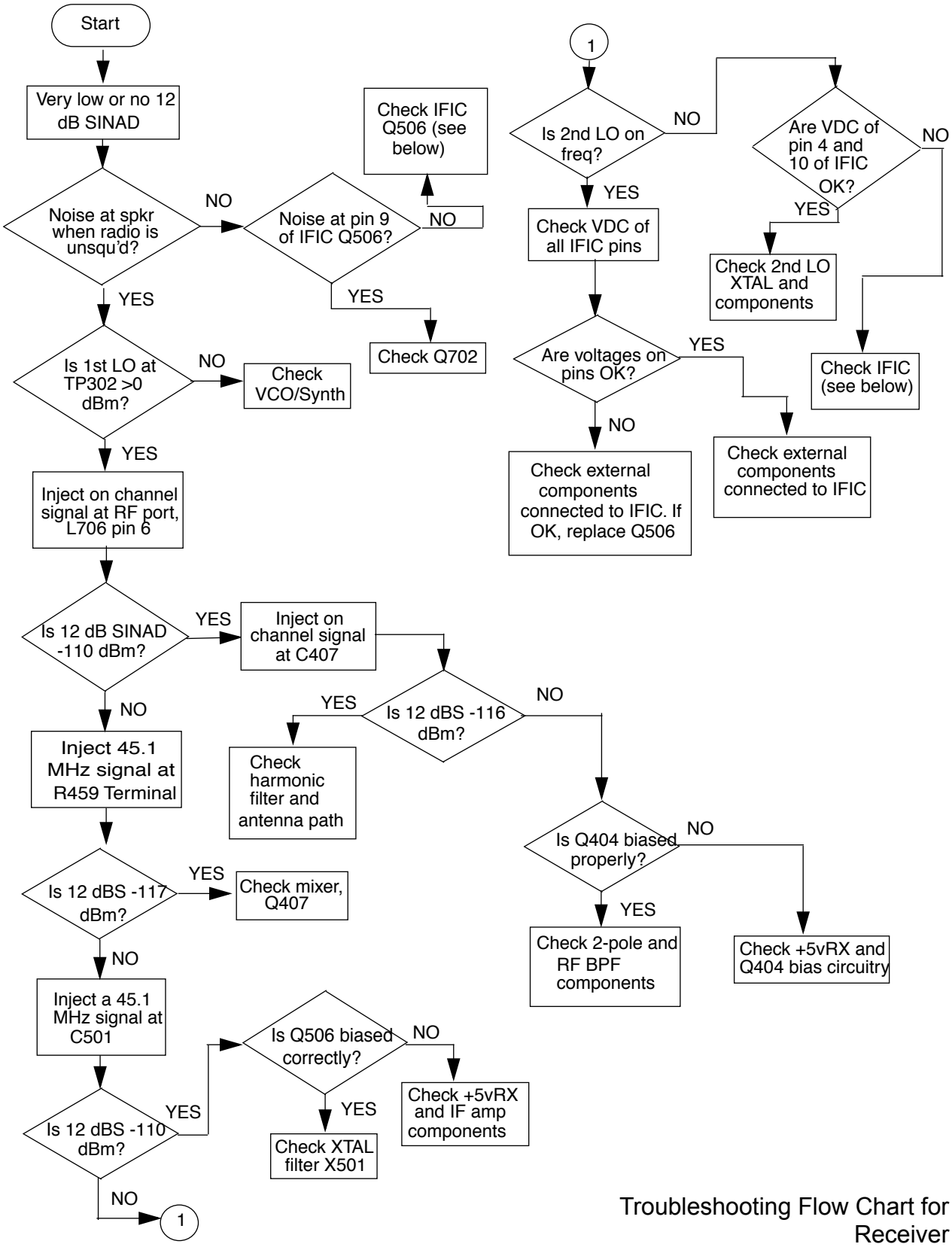
Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
R422	56 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 560	0662057A19
R423	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R424	12 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 123	0662057A51
R425	Not Placed	----------	----------	----------
R426	100 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 101	0662057A25
R427	12 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 123	0662057A51
R428	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R429	470 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 471	0662057A41
R430	100 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 101	0662057A25
R431	15 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 153	0662057A77
R432	220 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 221	0662057A33
R433	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R434	10 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 100	0662057A01
R435	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R436	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R437	680 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 681	0662057A45
R438	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 4R7	0662057W17
R439	15 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 153	0662057A77
R440	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R441	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R442	330 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 331	0662057A37
R443	330 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 331	0662057A37
R444	22 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 220	0662057A09
R445	0.1 ohm; 0.5W; +-5%	Rohm	MCR50 JZH J R10	N/A
R446	100 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 1003	0662057P95
R447	100 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 1003	0662057P95
R448	100 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 1003	0662057P95
R449	100 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 1003	0662057P95
R450	100 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 1003	0662057P95
R451	100 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 1003	0662057P95
R452	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R453	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R454	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R455	27 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 273	0662057A83
R456	1 M ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 105	0662057B22
R457	15 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 153	0662057A77
R459	560 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 561	0662057A43
R466	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R501	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R502	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R503	2.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 272	0662057A59
R505	2.2 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 222	0662057A57
R506	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R507	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R508	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R509	68 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 683	0662057A93
R510	470 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 474	0662057B14
R511	56 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 563	0662057A91
R512	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R513	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R514	3.3 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 332	0662057A61

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
R515	25.5 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 2552	0662057T92
R516	29.4 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 2942	0662057P29
R517	15.8 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 1582	0662057Z03
R518	11.5 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 1152	0662057Z35
R519	150 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 1503	0662057P97
R520	4.2 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 4221	N/A
R521	715 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 7153	0662057T99
R522	Not Placed	Rohm	----------	----------
R523	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R524	2.2 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 222	0662057A57
R525	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R526	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R527	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R530	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R531	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R532	564 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 564	0662057B16
R534	150 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 154	0662057B02
R535	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R536	1.5 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 152	0662057A53
R537	470 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 474	0662057B14
R538	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R539	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R540	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R541	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R542	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R543	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R544	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R545	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R546	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R547	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R548	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R549	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R550	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R551	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R560	5.11 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHF 5111	0662057P06
R561	634 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHF 6343	N/A
R563	2.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 272	0662057A59
R564	82 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 8202	N/A
R565	15 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 153	0662057A77
R566	18 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 183	0662057A79
R567	10 K ohm; 0.1W; +-10%	Rohm	NTH5G16P39A103K07 TH	N/A
R568	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R569	1 K ohm; 0.25W; +-5%	Hokuriku	CR1/4-102J	N/A
R601	3.3 M ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 335	0662057B34
R602	6.8 K ohm; 0.25W; +-5%	Rohm	MCR03 EZHJ 682	0662057A69
R604	6.8 K ohm; 0.25W; +-5%	Rohm	MCR03 EZHJ 682	0662057A69
R605	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R606	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R607	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R608	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97

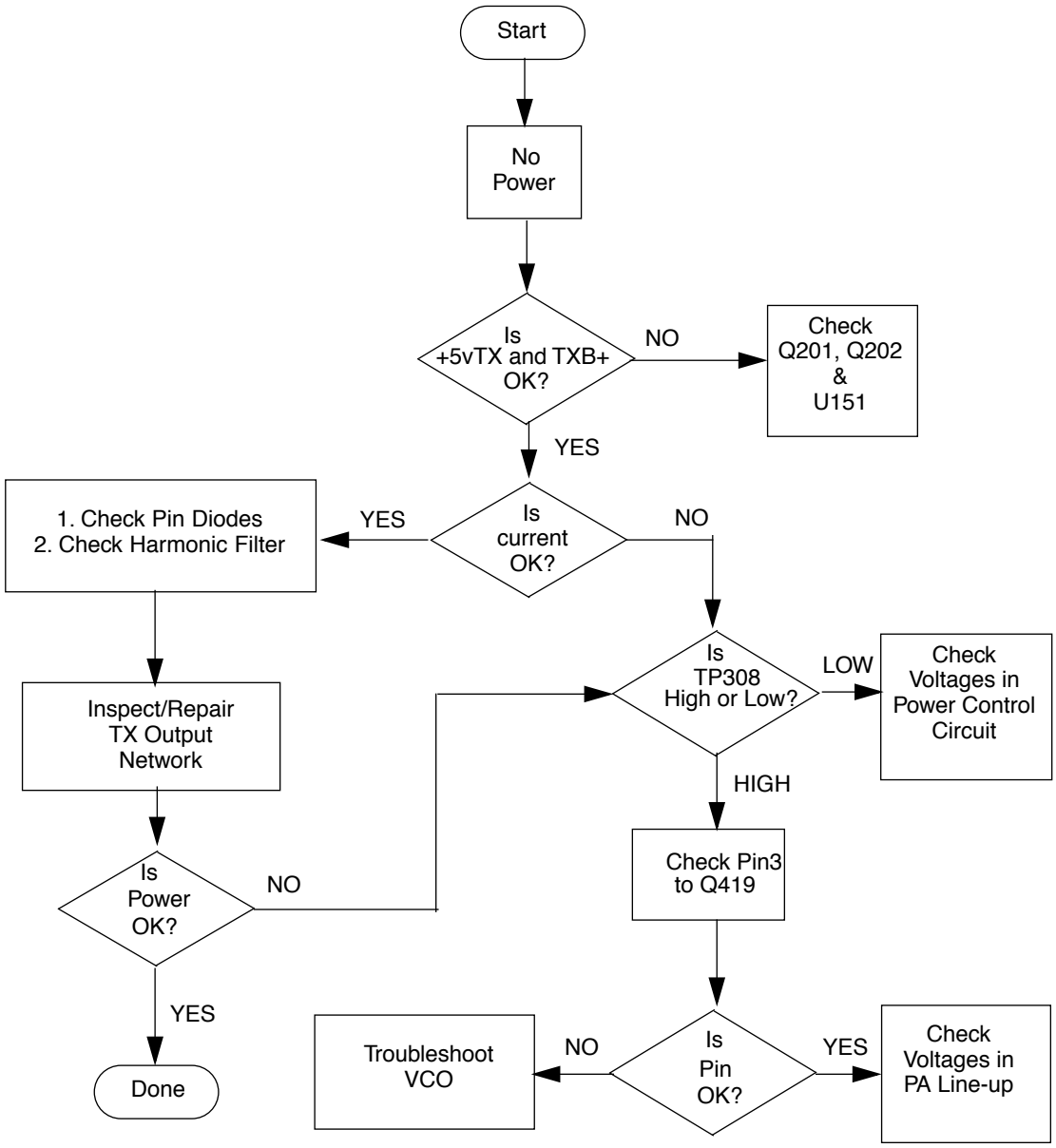
Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
R609	680 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 684	0662057B18
R610	22 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 223	0662057A81
R611	Chip Thermistor	Hokuriku	NSM3503J400J	N/A
R612	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R615	12 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 123	0662057A75
R616	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R617	220 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 224	0662057B06
R620	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R621	330 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 334	0662057B10
R622	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R625	18 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 183	0662057A79
R626	18 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 183	0662057A79
R627	680 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 684	0662057B18
R628	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R629	Not Placed	----------	----------	----------
R631	820 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 824	0662057B20
R632	33 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 333	0662057A85
R633	12 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 123	0662057A75
R634	680 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 684	0662057B18
R635	1.2 M ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 125	0662057B24
R636	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R637	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R638	330 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 334	0662057B10
R639	150 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 154	0662057B02
R640	150 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 154	0662057B02
R641	680 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 684	0662057B18
R642	33 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 3302	N/A
R643	22 K ohm; 0.1W; +-1%	Rohm	MCR03 EZHF 2202	N/A
R645	1 M ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 105	0662057B22
R646	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R648	470 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 474	0662057B14
R649	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R650	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R651	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R652	680 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 684	0662057B18
R654	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R655	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
R656	100 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 101	0662057A25
R657	0 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 000	0662057B47
R658	820 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 821	0662057A47
R659	12 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 123	0662057A75
R660	Not Placed	----------	----------	----------
R661	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R663	100 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 104	0662057A97
R701	2.2 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 222	0662057A57
R702	1.5 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 152	0662057A53
R703	470 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 474	0662057B14
R704	47 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 473	0662057A89
R705	22 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 220	0662057A09
R706	470 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 471	0662057A41
R707	3.9 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 392	0662057A63

Circuit Ref	Description	Vendor	Vendor Part Number	Motorola Equivalent Part Number
R708	2.2 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 222	0662057A57
R709	0.27 ohm; 0.125W; +-5%	Rohm	MCR10 EZHJ R27	0662057C02
R710	100 ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 101	0662057A25
R711	2.2 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 222	0662057A57
R712	1 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 102	0662057A49
R713	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R714	10 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 103	0662057A73
R715	4.7 K ohm; 0.1W; +-5%	Rohm	MCR03 EZHJ 472	0662057A65
RV601	10 K ohm; 0.1W; +-5%	Rohm	MVR22 HXBR N 103	N/A
RV602	10 K ohm; 0.1W; +-5%	Rohm	MVR22 HXBR N 103	N/A

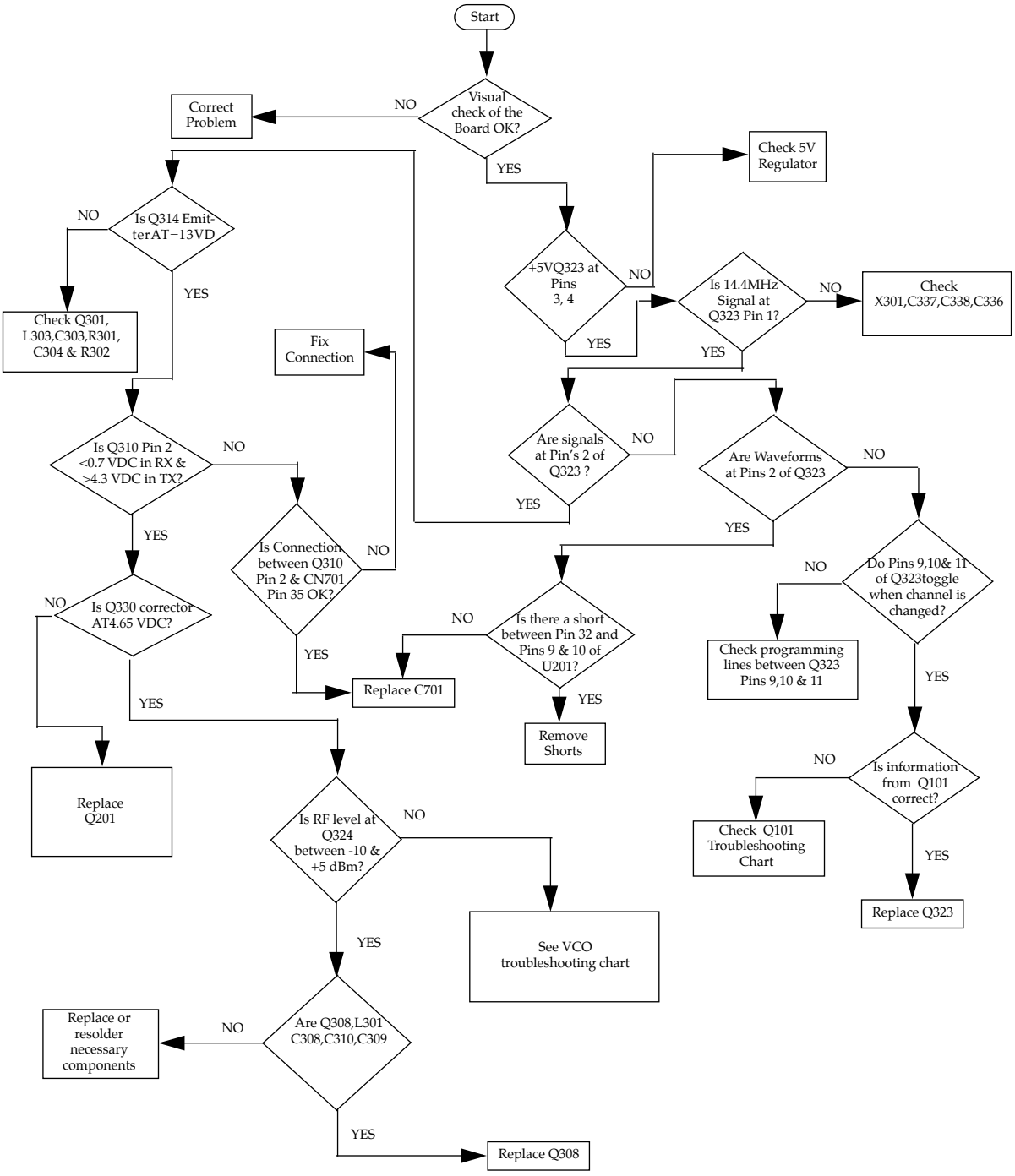
6.0 Troubleshooting charts



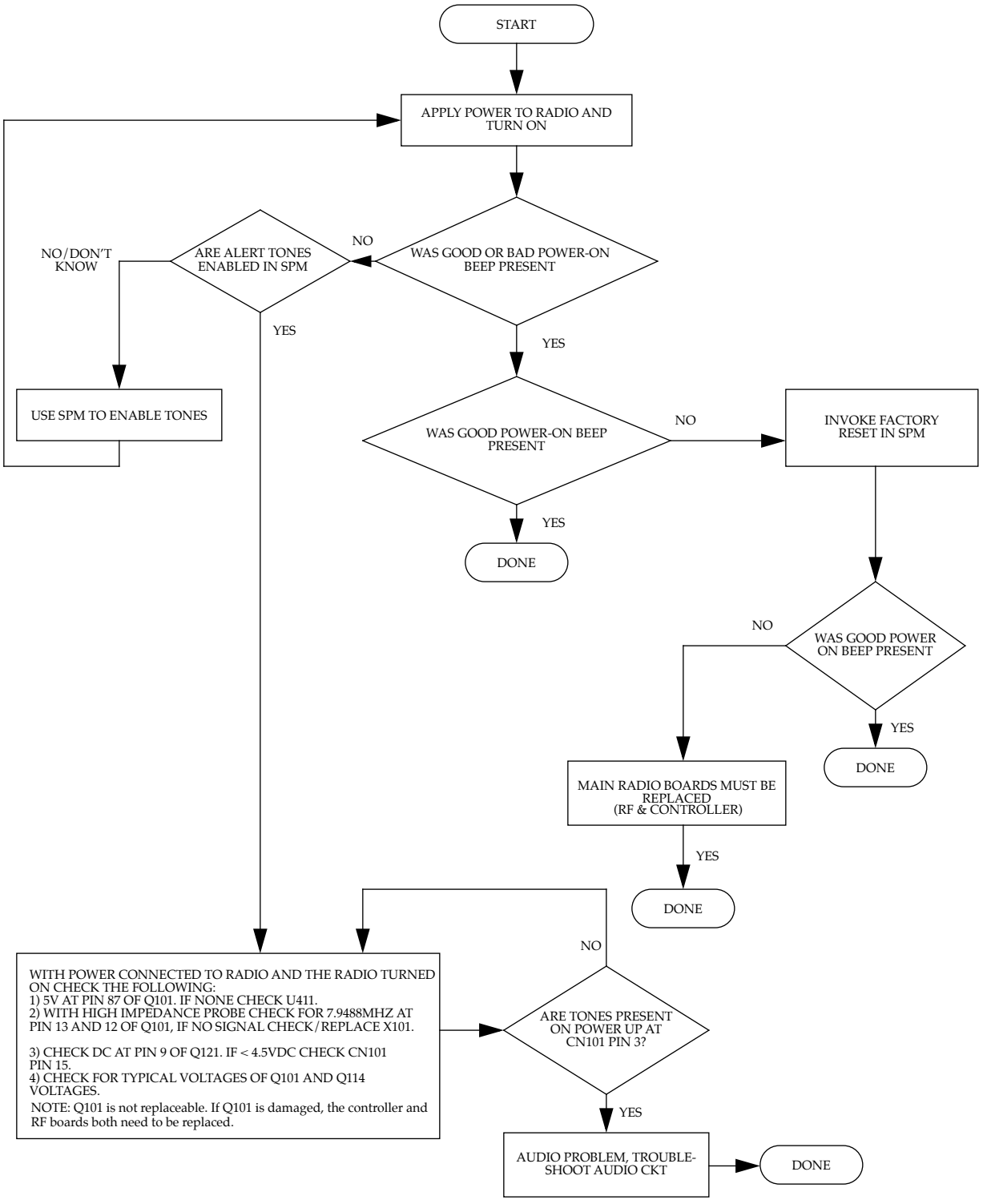
Troubleshooting Flow Chart for Receiver



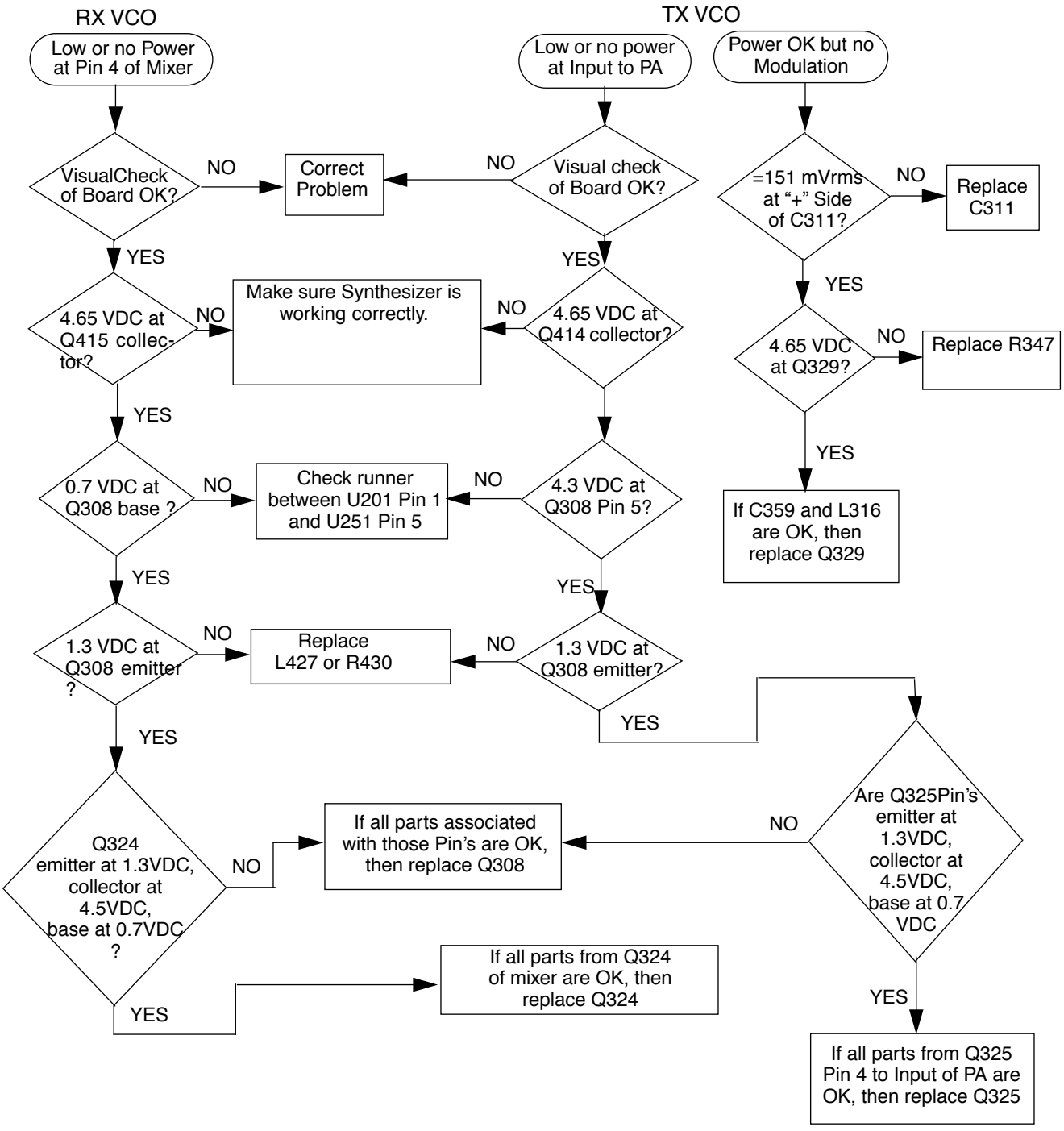
Troubleshooting Flow Chart for Transmitter



Troubleshooting Flow Chart
for Synthesizer


START
APPLY POWER TO RADIO AND TURN ON
WAS GOOD OR BAD POWER-ON BEEP PRESENT
NO
ARE ALERT TONES ENABLED IN SPM
NO/DON'T KNOW
YES
USE SPM TO ENABLE TONES
YES
WAS GOOD POWER-ON BEEP PRESENT
NO
INVOKE FACTORY RESET IN SPM
YES
DONE
WAS GOOD POWER ON BEEP PRESENT
NO
YES
DONE
MAIN RADIO BOARDS MUST BE REPLACED (RF & CONTROLLER)
YES
DONE
NO
WITH POWER CONNECTED TO RADIO AND THE RADIO TURNED ON CHECK THE FOLLOWING:
1) 5V AT PIN 87 OF Q101. IF NONE CHECK U411.
2) WITH HIGH IMPEDANCE PROBE CHECK FOR 7.9488MHZ AT PIN 13 AND 12 OF Q101, IF NO SIGNAL CHECK/REPLACE X101.
3) CHECK DC AT PIN 9 OF Q121. IF < 4.5VDC CHECK CN101 PIN 15.
4) CHECK FOR TYPICAL VOLTAGES OF Q101 AND Q114 VOLTAGES.
NOTE: Q101 is not replaceable. If Q101 is damaged, the controller and RF boards both need to be replaced.
ARE TONES PRESENT ON POWER UP AT CN101 PIN 3?
YES
AUDIO PROBLEM, TROUBLE-SHOOT AUDIO CKT
DONE

Troubleshooting Flow Chart
for Microcontroller



Troubleshooting Flow Chart for VCO

This page is intentionally left blank.

GLOSSARY OF TERMS

Term	Definition
Active Scan State	The state when the radio is in Scan Mode, and when the radio is rapidly moving through the Scan List Member channels looking for eligible transmission activity.
Busy Channel Lockout (BCL)	If BCL is activated, the radio will check for channel activity before transmitting. If activity is detected, transmission is prohibited. For carrier squelch mode, radio will not transmit, if it is receiving carrier. For coded squelch mode, it will not transmit, if it is receiving carrier with different PL/DPL code.
Carrier	An electromagnetic signal that is transmitted on a selected frequency for the purpose of carrying voice or data transmissions along with it. Carrier can then be received by all radios listening on that frequency.
Carrier Squelch (CSQ)	When the carrier energy exceeds the carrier energy threshold, known as the Squelch Level, the radio unmutes.
CD	Compact Disk.
Channel	A single path separated by frequency or time divisions used for transmitting and/or receiving voice and/or data.
Channel Alias	Channel Aliases are radio-user descriptions for the radio's channels. Alphabets, numbers, spaces, "+", "-", and "/" can be used. Examples: EMT-001, 500, SECURITY.
Channel Bandwidth	The channel spacing when operating on the current channel.
Channel Enabled	When selected, the channel is enabled and accessible.
Coded Squelch	When the channel receives incoming message that contains the same PL or DPL code as its Rx PL/DPL code, the radio unmutes.
Codeplug	A solid-state chip inside a radio where the radio's personality data is stored.
Communications Port (COM Port)	A serial hardware interface connection at the back of a computer used to communicate with other hardware devices, such as radios, modems, and printers. Also known as a Serial Port. COM Ports are designated by slot positions such as Port1, Port2, Port3, Port4. When programming a radio, the computer is connected to the radio with a RIB cable via the COM port. The computer's CPS Com Port settings are independent of each other and apply to the Read and Write features.
CPS	Acronym for Customer Programming Software. Licensed Motorola software used to program two-way radios with a unique set of features.
CSQ	Carrier Squelch.
CTCSS	Acronym for *Continuous Tone Coded Squelch System*. A generic term for sub-audible tone/ code used to create communications groups. Also see *PL*.
Digital Private Line (DPL)	DPL is a digital format transmitted along with the carrier. DPL allows for more use and privacy on a frequency. DPL is transmitted at a sub-audible (not able to be heard) frequency.
DPL	Digital Private-Line™

Term	Definition
DTMF	Dual-Tone Multi-frequency. A Signaling System protocol widely used in the telephone industry. Two tones are transmitted simultaneously at different amplitudes for each keypad key press. A sequential series of Dual Tones makes a data word.
DTMF Tx Tone Duration	DTMF Tx Tone Duration is the amount of time that a DTMF tone is transmitted for a single digit. Once this Tx Tone Duration ends, the DTMF Tx Tone Interval begins, and vice-versa.
DTMF Tx Tone Interval	DTMF Tx Tone Interval is the amount of time that the radio waits between DTMF digits. Once Tx Tone Interval ends, the DTMF Tx Tone Duration begins, and vice-versa.
EEPROM	Electronically Erasable/Programmable Read-Only Memory: used by the radio to store its personality.
Firmware	Software, or a software/hardware combination of computer programs and data, with a fixed logic configuration stores in a read-only memory. Information cannot be altered or reprogrammed.
FGU	Frequency Generation Unit.
Frequency	(a) The location of the center of a channel of operation in the radio spectrum. Measured in Megahertz (MHz). (b) A computer speed. Measured in Megahertz (MHz).
Hard Pot	Hardware potentiometer for adjustment of parameter settings.
Home Channel	The channel where scan is started.
Individual Call Acknowledgement	If activated, the radio would send the preprogrammed Acknowledgement ID when an Individual Call is received.
Landed Scan State	When the radio is in Scan Mode, and once Active Scan finds an eligible Scan List Member channel/call to receive or unmute to, the radio is then in Landed Scan State. Also, once both Transmit and Receive activity has ceased, and while the Scan Hang Timer is counting down, the radio is still in Landed Scan Mode.
Latest Codeplug Version	The most recent version number of codeplug information that was loaded into the radio. This is stored in the radio's codeplug.
LCD	Liquid Crystal Display: a module used to display the radio's current operating channel info or status message.
Long Press Function	Function that is invoked if the button is pressed and released after one second.
Lower Scan Frequency	The lower limit that VFO will scan.
Maximum Frequency	The highest frequency setting at which the radio is allowed to operate. The radio's frequency range is defined as being between, or equal to, the Minimum and Maximum frequencies. This information is stored in the radio's codeplug.
Minimum Frequency	The lowest frequency setting at which the radio is allowed to operate. The radio's frequency range is defined as being between, or equal to, the Minimum and Maximum frequencies. This information is stored in the radio's codeplug.
Model Number	The model number identifies the type of radio. This information is stored in the radio's codeplug.

Term	Definition
Normal Scan	For Normal Scan, the radio assigns equal priority to all members in the Scan List selected for the current channel. When the radio is scanning a Scan List (Active Scan), all scan list members (including the Home Channel) will be allocated equal time to be scanned. For example, if the Home Channel is H1, and the Scan List Members are Nn, then the scanning sequence is: N1, N2, N3, ..., H1, N1, N2, ..., etc.
Offset Frequency	If Tx Offset is set to Positive, this frequency will be added to the VFO Rx Frequency when radio is transmitting. It will be subtracted from the VFO Rx Frequency if Tx Offset is set to Negative.
Original Codeplug Version	The first version number of codeplug information that was loaded into the radio. This is stored in the radio's codeplug.
PC Board	Printed Circuit Board.
Phone Access Code	The 16 digit Access Code for establishing connection to a telephone line and subsequent dial tone.
Phone De-access Code	The 16 digit De-access Code for disconnecting from a phone call.
Phone List	A list of phone numbers (up to nine phone numbers) that can be preprogrammed into the radios. Each phone number can contain 16 characters made up by alphabets (A, B, C, D), numbers (0-9), spaces, "#" and "*".
PL	Private-Line® tone squelch: a continuous sub-audible tone that is transmitted along with the carrier.
PL Required For Selective Call	If activated, the radio would need to receive matching Selective Call ID as well as PL/DPL code in order to unmute on the current channel.
PLL	Phase-Locked Loop: a circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
Pretime	Selects the amount of time between PTT button press and the first digit of ID transmission. This time allows the receiving radio to stabilize before receiving data.
Priority Scan	For Priority Scan, the radio assigns the highest priority to the first member in the Scan List selected for the current channel. When the radio is scanning a Scan List (Active Scan), 50% of the scans are targeted at the Priority #1 Member channel. For example, if the Priority #1 Member is P1, and the non-priority Scan List Members are Nn, then the scanning sequence is: P1, N1, P1, N2, P1, N3, P1, N4, P1, N5, etc.
Priority #1 Scan List Member	The first member in the current Scan List. When the radio is scanning a Scan List (Active Scan), 50% of the scans are targeted at the Priority #1 Member channel. Example: If the Priority #1 Member is P1, and the non-priority Scan List Members are Nn, then the scanning sequence is: P1 N1, P1 N2, P1 N3, P1 N4, P1 N5, etc. **Note**: When the radio's speaker is unmuted to a non-priority call (Landed Scan mode), the radio continues to mute at a specific time interval (the Scan Interval Time), and scan for transmission activity on the Priority #1 Member channel. If the radio discovers a valid Priority #1 transmission, it drops the current transmission, and unmutes to the Priority #1 call. Priority Scan has to be enabled (per channel) for this feature to function.
Prime Channel Return Hang Time	The amount of time that the radio will stay idle in another channel before reverting back to the Prime Channel.

Term	Definition
Private Line (PL)	A sub-audible tone/code used to create unique/private communication groups while operating in Conventional Dispatch mode. A generic term for Tone Private Line (TPL), or Digital Private Line (DPL).
Program	The transfer of CPS information from the computer's temporary memory (RAM) to the radio.
PTT	Push-To-Talk: the switch located on the left side of the radio which, when pressed, causes the radio to transmit.
PTT ID Select	If PTT ID is activated for the channel, then PTT ID will be sent following the PTT ID Transmission Type.
PTT Short Sidetone	PTT Short Sidetone causes the radio to sound one short alert tone, after the PTT button is pressed, and immediately following the ID being transmitted. The purpose is to indicate to the radio-user when voice may be initiated.
Random Access Memory (RAM)	A temporary storage space used by a computer to operate a software program currently running. Anything stored in RAM is lost when the computer is turned off.
Registers	Short-term data-storage circuits within the microcontroller.
Repeater	Remote transmit/receive facility that retransmits received signals to improve communications coverage.
RESET	Reset line: an input to the microcontroller that restarts execution.
RF PA	Radio Frequency Power Amplifier.
Radio Interface Box (RIB)	Used to connect a personal computer to a radio for the purpose of communication between the two. The RIB consists of level-shifting circuits that convert from the standard RS-232 voltage levels of the computer asynchronous serial interface (COM Port) to the single-ended voltage levels present on the Serial Bus contacts of the radio's connector. The RIB must have an appropriate RIB-to-radio and RIB-to-computer Radio Interface Cable for communication and radio programming to occur.
Receive Frequency	A designated frequency used when receiving carrier for the current channel.
Reverse Burst / Turn Off Code	Causes a Tone Private Line (TPL) or Digital Private Line (DPL) code to be transmitted at the end of a transmission - once PTT is released, and while operating on the current channel. This sub-audible tone causes the receiving radio to mute its speaker before loss of a carrier is detected. Muting the speaker eliminates unwanted noise (squelch tail) during loss of carrier detection.
ROM	Read Only Memory.
RSSI	Received Signal-Strength Indicator: a dc voltage proportional to the received RF signal strength.
RPT/TA	Repeater/Talk-Around.
Rx DPL Code	The specific code accepted when receiving Digital Private Line (DPL) encoding, while operating on the current channel.
Rx DPL Invert	Setting Rx DPL Invert causes Digital Private Line (DPL) signals to be inverted when they are received by the radio, while operating on the current channel. Inverted coding allows for more traffic/usage on frequencies.

Term	Definition
Rx TPL Frequency	A designated frequency used when receiving Tone Private Line (TPL), while operating on the current channel. This frequency can directly correlate to the Rx TPL Code field; however, non standard code frequencies may also be selected.
Scan List	The Scan List determines which channels the radio scans, when operating in the Scan Mode, on the current channel.
Scan List Member	The Scan List allows you to select the grouping of channels that make up the current Scan List Member channels. This grouping of Scan List Member channels can then be scanned for transmission activity - one at a time, when the radio is in Scan Mode. A Scan List can have a maximum of 16 Scan List Members. Scan List Member scanning priority is definable. A Scan List can be assigned to a channel. Three Scan Lists are available. A Scan List can be assigned to more than one channel.
Scan Mode	When the radio is in one of the two Scan States: Active Scan and Landed Scan. This mode is initiated when the programmable SCAN button is pressed.
Scan Type	There are two types of scanning available on the current Conventional Personality: Normal Scan or Priority Scan.
Selective Call	Also known as Selcall. This call that allows you to selectively call a radio or group of radios based on a Call List - Individual, Group, and All ID's.
Serial Number	Each radio has its own unique serial number. This information is stored in the radio's codeplug.
Short Press Function	Function that is invoked if the button is pressed and released within one second.
Softpot	Software Potentiometer: a computer-adjustable electronic attenuator.
Software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
Squelch	Muting of audio circuits when received signal levels fall below a pre-determined value.
Squelch Level	The amount of carrier energy required to unmute the radio's speaker upon satisfying the selected Carrier Squelch threshold. Low level allows more transmissions with less clarity to unmute the radio's speaker. High level increases the squelch threshold causing a stronger carrier signal to be required before the radio's speaker will unmute. This helps to reduce unwanted noise.
Tone Private Line (TPL)	Transmitted when the receiving radio is to only receive calls from radios with specific TPL codes, this creates communications groups while operating in Conventional Dispatch mode. TPL allows for more use and privacy on a frequency. TPL is transmitted at a sub-audible (not able to be heard) frequency. Also known as *CTCSS*.
TOT	Time-Out Timer: a timer that limits the length of a transmission.
TPL	Tone Private-line.
Tx DPL Code	The Digital Private Line (DPL) code that transmits while operating on the current channel.

Term	Definition
Tx DPL Invert	Setting Tx DPL Invert causes Digital Private Line (DPL) signals to be inverted before they are transmitted from the radio, while operating on the current channel. Inverted coding allows for more traffic/usage on frequencies.
Tx Frequency	A designated frequency used when transmitting carrier for the current channel.
Tx Offset	The offset that will be added to the VFO Rx Frequency when radio transmits in VFO mode. Available options are: None (transmits using Rx Frequency), Pos (transmits using Rx Frequency + Offset Frequency), Neg (transmits using Rx Frequency - Offset Frequency), User (transmits using the User Defined Tx Frequency)
Tx Power	The transmit power level while operating on the current channel. **High**: Used when a stronger signal is needed to extend transmission distances. **Low**: Used when communicating in close proximity, and to keep the radio from transmitting into other geographical groups operating on the same frequency. **Economy Low**: Used when communicating distance is close, e.g., within the same warehouse, stadium, etc.
Tx TPL Frequency	A designated frequency used to transmit Tone Private Line (TPL) encoding, while operating on the current channel. This frequency can directly correlate to the Tx TPL Code field; however, non standard code frequencies may also be selected.
µC	Microcontroller.
UHF	Ultra High Frequency.
Unmuting	A radio unmutes, when it opens its speaker to receive audio.
µP	Microprocessor.
Upper Scan Frequency	The upper limit that VFO will scan.
User Defined PL Frequency	You can customize up to three non standard PL frequencies to provide more choices for PL.
VCO	Voltage-Controlled Oscillator: an oscillator whereby the frequency of oscillation can be varied by changing a control voltage.
VFO	Variable Frequency Operation. The radio user chooses frequencies instead of preprogrammed channels to operate the radio.
VFO Scan	Radio scans the preprogrammed frequency range defined by VFO Upper Scan Frequency and Lower Scan Frequency in the increment defined by Frequency Step Size.
VHF	Very High Frequency.
VSWR	Voltage Standing Wave Ratio

Technical Information Updates

As we continue to make engineering enhancements to our products, the information in our Service Manuals need to be updated accordingly. If you wish to be informed of these updates, kindly fill in and fax us your details.

Fax to: 6-04-6124944

The Technical Publications Coordinator,
Media and Communications,
R&D Department,
Motorola Penang.

_____

Your Details

Name/Contact Person: _____

Company Name: _____

Address: _____

_____

_____

_____

Telephone No.: _____

Fax No.: _____

Email Address: _____

How would you like to receive the update notification?

Through: o **mail** o **email** o **fax**

Manual No.: 6804112J41

Kindly complete the Service Manual Feedback Form on the next page to help us ensure that you receive the most accurate and complete information.

Service Manual Feedback Form

We believe that reports from users provide valuable information for producing quality manuals. Kindly take a few moments to provide feedback on this manual. Thank you for your cooperation.

Fax to: 6-04-6124944

The Technical Publications Coordinator,
Media and Communications,
R&D Department,
Motorola Penang.

1. Please check all the appropriate boxes:

	Complete	Incomplete	Correct	Incorrect	Clear	Confusing	Size Adequate	Size Too Small	Not Covered in this Manual
Disassembly Procedures									
Alignment Procedures									
Exploded Views									
Schematic Diagrams									
Circuit Board Details									
Electrical Parts List									
Exploded View Parts List									

2. How do you rate this particular Service Manual?
   o excellent o very good o good o fair o poor
3. Did this Service manual provide you with the information necessary to service and maintain the specific equipment?
   o very much so o generally yes o to some extent o no
4. We would appreciate any corrections or recommendations for improving this manual. Please include the specific page number(s) of the diagram or procedure in question.

5. General comments/suggestions:

Manual No.: 6804112J41